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AT

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VOL. XVII.

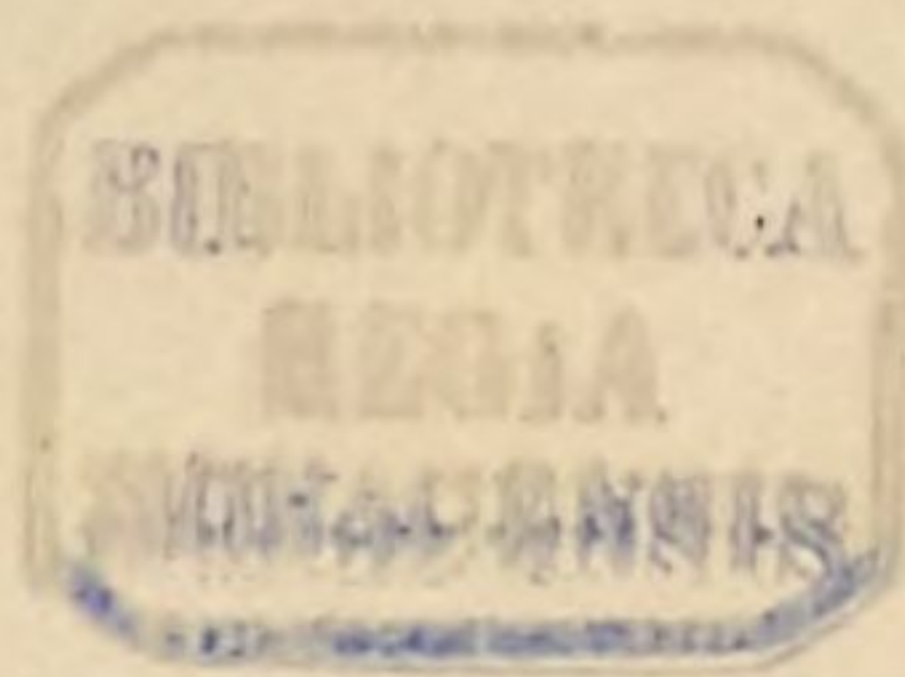
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Memoirs of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE.

VOL. XVII. No. 1.

THE

IMMATURE STATE OF THE ODONATA.

PART III. — SUBFAMILY CORDULINA.

BY LOUIS CABOT.

WITH SIX PLATES.

CAMBRIDGE, U. S. A.:

Printed for the Museum.

FEBRUARY, 1890.

THE
IMMATURE STATE OF THE ODONATA.

PART III. — SUBFAMILY CORDULINA.

PREFACE.

THERE are now one hundred and ten species of *Cordulina* on record, and thirty-three species are found in North America. As shown in the Bibliography, the immature states of three European species are described, two of them more than one hundred years ago, and of two North American species, five in all. Twenty-three have been described and figured here, of which nine only are raised; i. e. four from Europe, one from Australia, and four from North America. The other fourteen are determined by supposition.

To the Legio *Macromia* belong eight species, to the Legio *Cordulia* fifteen. Of these, eight species belong to the genus *Epithea*, and seven species to the genus *Cordulia*. The genera *Hemicordulia*, *Gomphomacromia*, *Tetragoneuria*, and *Synthemis* are not yet known in the immature state, and may probably modify some of the statements here given. Perhaps some groups as yet considered to belong to the Libellulina may be recognized to be *Cordulina*; but this can only be decided when the subfamily Libellulina is thoroughly studied.

It has been decided to add the descriptions of *Pantala* and *Tramea* to those of the *Cordulina*, rather than to those of Libellulina, as perhaps fuller material may result in placing them as an intermediate group.

BIBLIOGRAPHY.

1730. Joh. Leon. Frisch, Beschreibung von allerley Insecten in Deutschland, Vol. VIII. p. 20, no. ix., pl. ix. f. 1 and 2. The figure belongs undoubtedly to *Epitheca bimaculata*. The short description of the nympha is good. Frisch says that it belongs to a species with a flat abdomen, but he tells nothing else about the Imago, which has been raised by Dr. H. A. Hagen.
- Laur. Roberg, De Libella Insecto, 1732, p. 9, fig. c, d, has given a bad copy of Frisch's figure.
1749. J. Roesel, Insectenbelustigung, Vol. II. p. ii. no. iii. pp. 20-27, tab. 5, f. 1, 2. Roesel figures, f. 1, the nympha, and, f. 2, the male imago, which he had raised, *Cordulia aenea*. His figures and description are sufficient.
1771. Ch. De Geer, Mémoires, Vol. II. p. 687, pl. 19, f. 1-3 (German Translation, Vol. II. Part II. p. 52). The nympha of *Libellula aenea* is described; the figures are indifferent.
1853. H. A. Hagen, in his paper, "Ueber Leon Dufours Libellen Larven," Stettin. Entom. Zeit., Vol. XIV. p. 263, describes the nymphæ of the group *Cordulia*; *C. aenea* raised by Hagen, *C. metallica* raised by Brauer, and *E. bimaculata* raised by Hagen. — Translation by A. de Borré, 1881, in Compt. Rend. Ent. Soc. Belge, Vol. XXV. pp. 69, 70.
1857. Fr. Brauer, Neuroptera Austriaca, p. xv, gives a review of the nymphæ of *Cordulia* and *Epitheca*.
1871. A. S. Packard. — First Ann. Report on the Injurious and Beneficial Insects of Massachusetts; 18th Ann. Rep. Mass. Board of Agric., p. 379, pl. 1, f. 10, *Cordulia lateralis* Burm.; f. 11, *Didymops* (*Macromia transversa* Say). Both species are described; the figures are indifferent. The same paper reprinted, Boston, 1871, p. 31. Only the figures are repeated in Packard's "Guide," 3d edit., pl. 15, f. 10, 11; also in the following editions to the 8th, 1884. The plate 15 is the same formerly plate 1. The same figures numbered 98 and 99 are repeated in Amer. Naturalist, 1871, p. 427. Both types are in the Museum of Comparative Zoölogy at Cambridge.

THE
IMMATURE STATE OF THE ODONATA.

PART III. — SUBFAMILY CORDULINA.

LEGIO MACROMIA SELYS.

THE Legio Macromia is divided into three genera. The previous stages of two of them are not known. The third, the very characteristic subgenus Macromia, contains at least one species that has been raised. Of the eight species known to belong to Macromia, *M. transversa* has been raised, and among the others are some belonging probably to described species. There are forty living species described.

GENUS? (**EPOPTHALMIA** ?).

PLATE I. FIG. 1.

1. SPECIES ?

One male and three female nymphæ from Mr. H. Edwards; all were received from Canton, China, and he supposes that they were collected near that city.

Length, 31 mm.; breadth, 15 mm.; hind leg, 35 mm.

Head large, the breadth twice the length; a deep triangular excavation between the eyes, which nearly reaches the occiput, and is divided by a straight suture with a depressed stripe on each side; vertex in the middle of the excavation, just behind the antennæ, inflated heart-shaped, divided by a longitudinal depression; ocelli indicated; sides of the head rather convex, on each outer hind angle a nipple-shaped projection; occiput slightly notched in the middle of its posterior border; eyes small, projecting, rounded on top; antennæ about as long as the head, the two basal joints thickest, the first cylindrical, long, the second half as long, rounded at tip; setæ much more slender than usual, third joint as long as the two basals

together; fourth joint shorter than the third; anterior border of the forehead forms a short triangular horn, not excavated above, rounded at tip, about as long as the basal joint of the antennæ.

Mask very extraordinary, extending between the middle legs, as far as an elevated transverse ridge between the hind legs; basal part long, much bicarinated underneath, enlarged forward, forming at the middle two lobes; palpi comb-like, about as long as the basal part, but narrow, not interlocking; the interior edge has six strong teeth, widely separated; the apical tooth very short, the two following very long, the three (or four) basal ones shorter; the apical half of all teeth black; the two longest ones cross each other; movable hook very short, sharp. Prothorax a little narrower than the head; an elevated ridge in front, and an elevated ridge around the whole hind part, which is traversed by another elevated ridge; stigma large, uncovered; dorsal parts of thorax quadrangular, with an elevated somewhat angular formation of the middle portion; wing covers reaching the end of sixth segment or a little farther; the venation is not so far advanced as to be conclusive, but so far as can be seen it seems to be analogous to *Macromia*; it shows a blackish spot on the nodus of all wings, a blackish stripe along the radius to the nodus, and two blackish spots on the hind border extending upwards on the wing, and perhaps a blackish border around the basal part of hind wings.

Abdomen large, ovate, roof-shaped, sixth segment and that following tapering; side margin very sharp with a fringe of short bristles. The apical half of the abdomen with longer tufts of hairs. Segments of equal length except the last, which is only half as long as the rest; lateral spines on eighth and ninth segments sharp, straight, on eighth very short, on ninth longer than last segment, black at tip; the lateral spines belong to the dorsal part of the abdomen just as in *Macromia*; dorsal hooks on segments third to ninth; it is impossible to ascertain whether there is a hook on the second; hooks compressed, connected with the whole length of segments, their tips pointing towards the end of abdomen, extending beyond the segments; hook of third segment cylindrical; dorsum of last segment slightly inflated in the middle, an indication of a hook; the anal appendages a little longer than the last segment, forming a thick short pyramid, breadth and length equal; the dorsal median as long as the inferiors, triangular, flat, rather roof-shaped, in the male has no inflation; the inferiors sharp, pyramidal; the laterals a little shorter, flat, triangular; all villous, with long hairs on inner side.

The ventral side of the abdomen rather flat, with two incurved sutures, ending in the apical inner angle of ninth segment; the sutures slightly incurved as far as the eighth segment; straight on the eighth and ninth, on which the middle part is slightly narrower, the lateral parts about half the breadth of the central one; on the lateral part of the sixth is a transverse opening for the ventral bag; on the following segment a similar fold perhaps exists; abdominal stigmata very small; end of ninth ventral segment very hairy; genitals not very plainly marked.

Legs as far apart at base as in *Macromia*; strong, flattened, long, hind femur reaching the ninth segment; tibia about same length; tarsus a little shorter than tibia; first joint very short, the two others long, of equal length; claws shorter than the last joint of tarsus, slightly incurved; femur with three black bands.

These nymphæ differ from *Macromia* only in the shape of the mask, which is not spoon-shaped, but comb-like, the palpus not meeting. All other differences are slight and unimportant. Some species related to *Macromia* is suggested, and principally the large species of the genus *Epophthalmia*, of which *E. elegans* is found in China. But it must be remembered that the wing covers show very plainly that the wings of the imago must be profusely spotted with black. Up to the present time no such species is known.

I had at first supposed this nymphæ might belong to *Chlorogomphus*, an aberrant genus near *Cordulegaster*. The antennæ, the three jointed tarsi, and the spotted wings would suggest such a reference, but the extraordinary shape of the mask is as foreign to *Gomphina* as to *Cordulina*. The general appearance of the nymphæ, the shape of the body, the long legs with three black bands, the head with the frontal horn, is much like *Macromia*. I do not believe that the nymphæ belongs to the *Gomphina*, but probably to *Epophthalmia*.

MACROMIA. (Raised.)

Rambur, Neur., p. 137. — 1842.

De Selys, Synops. Cordulines, II. Addit., p. 31. — 1878.

The nymphæ of the genus *Macromia*, as accepted by De Selys in his last publication and divided into five subgenera, are of a uniform and peculiar character. The anterior part of the head just in front of the antennæ is

transformed into a large erect pyramidal horn, a character so far as known unique among the earlier stages of Odonata.

Head large, the breadth about twice the length; faceted eyes small, in the anterior corner of the head, prominent, conical, always rounded on top; the interior triangular prolongations do not meet each other; but they are continued above and below the eye, making on the sides of the head, and more or less behind the eyes, another triangular prolongation, which reaches nearly to the inferior border of the head. The small prominent eyes of the nymphæ are transformed in the imago into the separated tubercle on the middle of the hind margin of the eyes, and the non-faceted part represents the large eye of the imago.

Antennæ short, the two basal joints thicker than the seta, inserted in a cylindrical socket; first joint longer than the second, and more or less enlarged at tip; seta tapering, five-jointed; its second joint (the fourth of the antenna) shorter than its first, except in *M. tæniolata*; the others of equal length. The vertex very small, slightly convex; ocelli very slightly indicated, or not at all. The part behind the eyes is by far the largest part of the head, separated from the front part by a double curved transverse suture just behind the eyes; flat, rounded on both sides, notched behind, having a tubercle on each hind angle; in the Asiatic species, on each side of the median longitudinal suture is a tubercle, as in *Epithea*; this is indicated except in *M. transversa* in the American species. Mask large, the length greater than the breadth, its apical half spoon-shaped; the mask extends between the middle legs, where it is supported on each side by an elevated ridge. The basal part of the mask is triangular, nearly equilateral, its front margin is bent downward, and projects in an obtuse angle; the palpus large, hollowed out, triangular, nearly equilateral; its closely interlocking edge has six or seven teeth, the uppermost being smallest; the movable hook inserted a little back from the teeth, bent, sharp, long, but sometimes reaching only the base of the opposite one.

Prothorax narrower than the head; its hind part largest, as wide as the space between the hind tubercles of the head; stigma large, uncovered. The dorsal parts of the thorax flat, quadrangular; the wing cases in full-grown nymphæ reach the end of the sixth segment, or a little short of it.

Abdomen large, flat, about three fifths of the length of the body, ovate; breadth three fourths of length, roof-shaped; side margin very sharp, tapering on segments 7 to 8, and more abruptly on 9; segments 2 to 9 of equal

length, 10 very short, small, cylindrical, almost wholly inserted in 9; lateral spines on segments 8 and 9 triangular, flat, straight, tip very sharp; lateral spines on segment 8 short, half the length of 9; those on 9 as long as the anal appendages; the lateral spines belong to the dorsal part of the abdomen, as is shown by a suture on the ventral side, running very near the side margin. Dorsal hooks stout on segments 2 to 9 or 10; on 2 to 4 narrower, erect, more cylindrical; on the following ones compressed, their bases being connected with about the whole length of the segment; their tip seen sideways triangular, sharp, pointing towards the end of the abdomen; when present on segment 10, small, as an elevated ridge, the blunt tip sometimes extending beyond the segment. The anal appendages, a little longer than the last segment, form together a short pyramid; the dorsal median about as long as the inferiors, triangular, broad; in the male, the upper basal portion inflated; the inferiors pyramidal, sharp; the laterals smaller, sharper, shorter, or as long as the dorsal median. The ventral side of the abdomen flat, with two longitudinal sutures ending in the apical inner angle of segment 9; the central and lateral parts of the venter about equal; on the base of segment 6, on each side, in the lateral space, a deep transverse opening for the entrance to the ventral bag; the abdominal stigmata small; the genitals very slightly marked; hind legs far apart at base, a little more so than middle legs; fore legs nearer together; just behind the hind legs a transverse ridge with a round or oval median tubercle; legs very long, successively longer, the femur of hind legs reaching the ninth segment or beyond; thin, cylindrical, femur slightly flattened, as long as the tibia, or longer; tarsus about half as long as the tibia, three-jointed; first joint very short, the two others long, equal in length; claws as long or shorter than the last joint, thin, very sharp, slightly bent; the bifid character of the claws of the imago is not indicated in the nymph. Thorax and abdomen often variegated with gray and white, forming a series of ill-defined spots; femur generally has three black bands. During the transformation, the anterior curve of the split of the skin near the eyes passes through the non-faceted portion, which surrounds the eyes anteriorly.

Of the subgenera of the large genus *Macromia*, as accepted in 1878 by De Selys in his Second Additions to his Synopsis of Cordulina, the twenty-three first species belong here, to which one new species from Borneo may be added. Six species of those recorded are from the United States.

Until now only one species, *M. transversa*, has been raised; a second is supposed to belong to *M. illinoensis*, because two larvæ have been found in Massachusetts, where this species is the only one caught till now. A third is supposed to belong to *M. magnifica*, because a specimen and a nymph skin were found in the same locality and at the same time in Washington Territory (though nymph and imago are of different sexes), and no other species is known in this region. Other suppositions are suggested, but yet to be proved. At all events, it is undoubted that all species described belong to *Macromia*.

2. *MACROMIA TRANSVERSA*. (Raised.)

PLATE I. FIG. 3.

- Imago.* *Libellula transversa* Say, Journ. Acad. Philad., VIII. p. 19. 3, male.
Epophthalmia cinnamomea Burm., Hdb., II. p. 845. 2, female.
Didymops Servillii Ramb., Neur., p. 142. 1, male.
Didymops transversa Hag., Syn. N. A. Neur., p. 135. 1.
Macromia transversa Selys, Syn. Cordul., III. 70. (Second Addit., p. 44, accepted as Subgenus *Didymops*.)
- Nympha.* Packard, First Ann. Rep. on the Injurious and Beneficial Insects of Massachusetts, 18th Ann. Rep. Mass. Board of Agric., 1871, p. 379, *Didymops*? pl. 1, f. 11. The same (separate), Boston, 1871, p. 31, pl. 1, f. 11. — Only the figure is repeated, Pack., Guide, 3d ed., p. 713, pl. 15, f. 11; also in the following edit. (to 8th, 1884). The plate 15 is the same formerly pl. 1. The same figure numbered Fig. 99 is repeated by Packard, Amer. Naturalist, 1871, Vol. V. p. 427. The figure is hardly recognizable. (The type now in the Cambridge Museum.)

Four specimens have been raised: a female and its nymph skin, Woburn, Mass., from J. G. Shute; a female and its nymph skin, Worcester, Mass., from E. G. Ham, May 8, 1878; a male raised and another male just transforming, New England. Full-grown nymphæ or young ones of different size, dry and in alcohol, Cambridge, Mass., H. A. Hagen; Salem, Mass., coll. by Joseph True (type figured by Dr. Packard); Mass., from Fr. Sanborn; Orono, Me., from Prof. Fernald; Lake George, N. Y., H. A. Hagen; Ithaca, N. Y., Prof. Comstock; from Cedar Lake, Ill., October 17, 1882, and from Mackinaw, McLean Co., Ill., August 20, 1879, both from Prof. Forbes; from Green River, Ky., near Mammoth Cave, November 5, 1874, from F. W. Putnam; from Texas, Mr. Stolley.

Length of full-grown nymph, 27 mm.; breadth, 12 mm. Length of young, 9 to 25 mm.; breadth, 4 to 11 mm.

This species is not uncommon east of the Mississippi, from Canada (Quebec) throughout Maine, Vermont, Massachusetts, New York, Pennsylvania, South Carolina, and Georgia, and in the West from N. Illinois through Michigan to Kentucky. Numerous specimens of the nymph have been studied. Mus. Comp. Zoöl. I have never seen the imago from Texas, but a nymph from Mr. Stolley, and one in McLachlan's collection from Dallas, Texas, from J. Boll, are undoubtedly *M. transversa*; he has also the Texas imago from the same locality.

Body large, flattened, ovate; head somewhat villous, about half the breadth of the abdomen, transverse-oblong, the breadth nearly twice the length; the space between the eyes concave; the eyes nipple-shaped, rather small, projecting backward; part behind the eyes larger than in front, widely notched, sides bulging, villous, on each hind angle a very small tubercle; in general the anterior part before the suture is sprinkled with small tubercles and fine black dots; on each side a black band from the hind angles to base of the eye. A slight elevation on each side of the median line, slightly depressed in the middle, is perhaps analogous to the tubercles of *Epithea*; vertex small, round; ocelli indicated; anterior part of head slightly hollowed, the anterior border with pyramidal horn, somewhat longer than the basal joints of the antennæ, above thickly covered with papillæ-like spines. Antennæ short, first joint longer and thicker than second; seta a little thinner; joints 3 to 7 of about equal length, 4 a little shorter, 7 fine spindle-shaped. Mask large, strikingly spoon-shaped, extending between the middle legs. Wing cases reaching sixth segment; abdomen large, flat, breadth three quarters of length, ovate, truncated at tip, the outer edge very sharp; very slightly roof-shaped; segments equal, except the last one, which is very short, and inserted in the ninth; lateral spines on segments 8 and 9 compressed, triangular, very sharp; short on 8, extending as far as appendages on 9, covered with short bristles, as are also the margins of all segments; dorsal hooks on segments 2 to 9, thorn-shaped on 2 to 5; large, compressed, pointing backward on 6 to 9; anal appendages forming together a pyramid, length less than breadth; hairy, sharp, the dorsal median a very little shorter than the inferiors, and a little longer than the laterals; ventral longitudinal sutures nearly straight, ending in the apical angle of segment 9; lateral spaces nearly as broad as the median one;

ventral posterior edge of segment 9 fringed with hair; genitals slightly marked; ventral bags on base of segment 6; a suture near the ventral side-margins of segments 3 to 9. Legs very long, thin, cylindrical; hind legs wide apart at the base, a little more so than middle legs; fore legs nearer together; between middle legs are two elevated ridges, for receiving the base of the mask; between the hind legs is a rounded protuberance; hind legs a little longer than middle legs; fore legs shorter; femur of hind legs reaching segment 9; tibia a little shorter; tarsus half as long, first joint very short, second and third long, equal; claws long, sharp, incurved, not divided at tip.

Thorax and abdomen above much variegated with gray and white, forming a series of ill defined large pale-colored spots; femur with three blackish bands, tibia mottled with gray.

I have seen a large number of very young nymphæ, 9 mm. long, and full-grown ones. As the very young ones and those about full grown were collected together in fall and midwinter (December), they need probably two years for full development. They transform in the imago from May to June, so far as is known.

The principal characters which separate the previous stages of *M. transversa* from those of *M. Illinoiensis* are a narrower, saddle-shaped head, the abdomen truncate at tip, the want of any indication of a dorsal hook on the last segment, and longer lateral spines of ninth segment. The body is less flat and more roof-shaped before the young ones undergo the first change of the skin. These differences of the previous stage of *M. transversa* justify, perhaps, the retention of the genus *Didymops* of Rambur for this species.

3. *MACROMIA ILLINOIENSIS*. (Supposition.)

PLATE I. FIG. 2. PLATE II. FIG. 1.

Imago. *Macromia Illinoiensis* Walsh, Proc. Acad. Philad., 1862, p. 397. Selys, Synops. Cordul., p. 109, no. 69.

Nympha dry, and nympha skin, from Massachusetts; three nymphæ, one full-grown, locality not known, and one skin in alcohol, from Dendridge Junction, Tenn.; two nympha skins from Detroit, Mich., from H. G. Hubbard. Mackinaw Creek, Woodford Co., Ill., August 20, 1879; S. Ill., a large female nympha, two from Union Co., Ill., July 17, 1877; Peoria, Ill., October, 1878;—all from Prof. S. A. Forbes.

Length, 19 to 30 mm.; breadth, 9 to 13 mm.

Similar to *M. transversa*; body flatter, more hairy; head broader, nearly 8 mm., flat between the prominent eyes; slightly convex above, with a smooth depression along the middle line; hind tubercles of the occiput very visible; abdomen more ovate; less truncated; posterior edge of segment narrower; side margin of abdomen more hairy; dorsal hook on segment 10 visible, its tip sharp, sometimes extending beyond the segment; lateral spines shorter, on segment 9 not longer than 10th segment; apical ventral edge of segment 9 not hairy; appendages longer, dorsal median as long as the inferiors; laterals a little shorter, more pointed.

As *M. Illinoensis* has been found in Massachusetts and New Hampshire, and no other species there except *M. transversa*, the supposition that these nymphæ belong to *M. Illinoensis* is allowable. I am not able to separate from the above described nymphæ a skin from San Antonio, Tex., collected by Mr. A. Agassiz, nor a number from Dallas, Tex., collected by Mr. J. Boll, in McLachlan's collection. I should mention here that the specific character for *M. Illinoensis*, "dorsum of thorax without yellow bands," is to be corrected. There are before me two from Dallas with an abrupt yellow band on each side of the thorax, beginning just above the base of the middle legs, reaching only half the length of the thorax. These imagos cannot be considered to be a variety peculiar to Texas, as I have before me another female from Waco, Tex., from Belfrage, which has no yellow bands at all. This opinion is proved to be sound by two just sent to me by Mr. Ph. R. Uhler, which were caught by him in copulation, September 20, opposite Bittania Mills, Md. The male has the abrupt yellow bands on the dorsum of the thorax, which are wanting entirely on the female, as well as the narrow fascia along the ventral border of the thorax.

4. *MACROMIA ANNULATA* Var. *FLAVIPENNIS*. (Suggestion.)

PLATE II. FIG. 1.

Imago. *Macromia flavipennis* Walsh, Proc. Acad. Philad., 1862, p. 398.

Macromia annulata Hag., Syn. N. A. Neur., p. 132. 2; Syn. 1875, p. 56. 3.

Selys, Syn. Cordul., p. 107. 68.

One dry nymphæ, just transforming; thorax of the imago visible; from De Plaines River, near Chicago, Ill., from the late Mr. B. D. Walsh.

Length, 29 mm.; breadth, 10 mm.

Head very large and somewhat out of shape, being in process of transformation; eyes nipple-shaped, produced laterally and projecting backward; pyramidal horn sharp, longer than the basal joints of the antennæ, covered with stiff bristles, which are thickened at tip; antennæ shorter and thinner than in *M. Illinoensis*, 4th joint shorter than 3d; head flat above, sides straight, converging; at each side, on the hind angle, a small pointed tubercle; mask with very faint black dots, basal part equilateral; abdomen similar to *M. Illinoensis*, 10th segment a little longer, perhaps owing to the process of transformation, half as long as 9th, yellow; dorsal hooks also similar, an indication on 10th; long and sharp on 6th to 9th, more hook-shaped on the foregoing segments; lateral spines short, straight, sharp, on 9th about as long as segment 10; on 8th shorter; anal appendages stout, short, dorsal median as long as the inferiors, laterals a little shorter, sharper at tip; legs a little longer, ringed with black.

The type of Walsh was collected at the same locality with the imago, and was believed by him to belong to *Gomphus spinosus*. The imago type was burned in the Chicago fire; no second specimen is known. It was examined by Dr. Hagen in 1868, and it was found that a clerical error in the translation of the Latin description had prevented the identification with *M. annulata*. This species has a large yellow band on each side of the dorsum of the thorax, and unusually long light-colored hairs. The dorsum of the imago, ready to emerge from the nympha just described, shows exactly the same character.

5. *MACROMIA MAGNIFICA*. (Supposition.)

PLATE II. FIG. 2.

Imago. *Macromia magnifica* McLachl. (in litteris). Selys, Syn. Cordul., Add. II., 70 bis.

A male nymph skin from Umatilla, Oregon, June 25, 1882, from Mr. S. Henshaw. Length, 31 mm.; breadth, 11 mm.

Head large, broad, 8 mm.; eyes produced laterally and a little backward in blunt short cones; pyramidal horn short, broad, its tip rounded and very hairy; antennæ similar to *M. Illinoensis*, a little longer and thicker, joint 4 shorter than 3; sides of head more convergent, less produced, with a blunt point below near the mask; hind angles have rounded tubercles; basal part of the mask shorter than broad; wing cases reaching 6th segment; abdo-

men elongated, more lancet-shaped; dorsum higher; dorsal hooks smaller than in *M. flavipennis*, on segments 7 to 9 low, nearly their whole length connected with the dorsum, only the pointed tip free; on 10 a similar but smaller hook; lateral spines on 8 and 9 very short, sharp; last segment nearly half the length of 9th; anal appendages forming a broad short pyramid; appendages broad at base, not very sharp at tip; dorsal median shorter than the inferiors, dilated above (in male) near the tip; laterals a little shorter; space between the ventral longitudinal sutures broader than the laterals; apical edge of 9th ventral segment fringed with hairs; legs very long, mottled with black; femur of hind legs 14 mm. long; tarsus less than half the tibia.

There was collected on the same day and at the same locality a female imago. As this is the only *Macromia* known from Oregon, the supposition seems very plausible.

6. *MACROMIA TÆNIOLATA*. (Supposition.)

PLATE II. FIG. 4.

Imago. *Macromia tæniolata* Ramb., Neur., p. 139. 3. Hag., Syn. N. A. Neur., p. 132. 1.
Epopthalmia tæniolata Selys, Syn. Cordul., p. 90. 75.

One very large nympha from Volusia, Florida, Feb. 18, 1869, in alcohol, by Mr. J. A. Allen. Length, 36 mm.; breadth, 15 mm.

Body large, bulky, villous; head broad (nearly 10 mm.), transverse-oblong, the breadth more than twice the length, deeply notched behind; flat above between small conical projecting eyes; part back of the eyes much larger than the front part, both villous; sides convex with a fringe of longer hairs; a smooth band along the middle suture with a villous border on each side; hind angles oblique with a small rounded tubercle; front part separated by a curved suture from the hind part; vertex small; front border with a pyramidal horn, as long as two basal joints of antennæ, very villous; antennæ short, 1st joint enlarged at tip, which is villous; 2d inserted in tip of 1st, length half the breadth; seta half as thick as 2d, tapering to tip; joints 3 to 7 equally long, each a little longer than 1st; mask large; movable hook strong, sharp, short, its tip not extending beyond the base of the opposite one; the whole mask finely dotted with black.

Prothorax nearly as broad as occiput; wing cases reaching the end of 6th segment; abdomen large ovate, dorsum roof-shaped, side margin sharp, vil-

lous; lateral spines on segments 8 and 9 short, triangular, sharp, on 9 slightly exceeding the 10th segment; dorsal hooks on segments 2 to 10, small, erected on 2 to 5; long compressed, pointing backward on 6 to 9; smaller but reaching beyond tip on 10; anal appendages forming a pyramid a little longer than broad; hairy, sharp, dorsal median as long as inferiors; laterals a little shorter; ventral lateral spaces as broad as the median one; ventral apical edge of segment 9 not fringed with hairs; the female genitals very slightly marked by two small spines on the apical edge of segment 9. Legs as in *M. transversa*, very long, thin, only a little flattened; between the base of the hind legs an oblong pad; the four posterior tibiae with a fringe of hairs.

M. tæniolata is reported as found from Illinois and Pennsylvania as far as Georgia, and will probably be found also in Florida. The large size of the nympha makes the supposition very probable, as *M. tæniolata* is the largest known species.

7. *MACROMIA SPEC.*

PLATE III. FIG. 1.

Two probably full-grown nymphæ in alcohol, from Cadereita, south of Monterey, New Leon, Mex., by Mr. Couch, 1853.

Length, 25 to 27 mm.; breadth, 10 to 11 mm.

Similar to *M. annulata* var. *flavipennis*. Body shorter, less elongated; head very broad, eyes small, projecting backward; hind part of head slightly depressed in middle, with some longitudinal wrinkles, which are prolonged behind in two incurved branches; sides of head behind the eyes less prominent, convex; occiput narrower, slightly notched, on the hind angles a conical tubercle; vertex small; pyramidal horn broad, sharper at tip; second joint of antenna shorter than first; rest wanting; mask large, basal part strictly equilateral, produced in front in a very oblique angle; palpus equilateral; movable hook short, thin, sharp. Prothorax short, not exceeding the tubercles of hind angle; its sides bent up as triangular knobs; wing cases large, long, reaching 8th segment; length of abdomen a little greater than breadth, ovate; segments 7 to 10 roof-shaped, sloping; side margin sharp; segments of equal length, except 10th, which is half as long as 9th; dorsal hooks on segments 2 to 10; on 2 and 3 long erected sharp thorns; on 4 to 9 compressed laterally, the very sharp tip bent backward;

the hooks are longer on each succeeding segment, longest on 9th; hook on 10th very small, triangular, erected, blunt at tip; lateral spines on 8th and 9th segments flat, sharp, short; a little longer on 9th, half again as long as 10th; anal appendages twice as long as 10th segment, pyramidal, sharp; dorsal median hardly as long as the inferiors; tips slightly bent up; dorsal median of male inflated above nearly to tip; laterals a little shorter; the tubercle between the hind legs broad, ovoid; the space between the longitudinal ventral sutures broader than the lateral one; legs very long, femur of hind legs reaching about the end of the abdomen; tarsus half as long as tibia; claws very long, sharp. The shape and length of the dorsal hooks are the same in all specimens, and differ from all other species. As no species is known from Mexico, no supposition can be made.

8. MACROMIA MOOREI. (Supposition.)

PLATE II. FIG. 3.

Selys, Addit. Synops. Cordul., p. 17.

Four nymphæ in alcohol from Kooloo, Himalaya, from Rev. M. Carleton, Billespur, Sutledge River, 1872, none full-grown.

Length, 17 to 26 mm.; breadth, 7 to 11 mm.

Body villous; head transverse-oblong, breadth twice the length, nearly straight behind, above flat between small globular and subprominent eyes; hind part larger than the front part, sides below more convex and villous; hind angles oblique; a smooth groove on the median longitudinal suture; on each side of it a rounded tubercle; another smaller tubercle near each hind angle; transverse suture behind the eyes nearly straight; vertex small, rounded; front border has a pyramidal rather blunt horn, rounded above at tip, and covered with short stiff bristles; antennæ short, basal joint enlarged at tip, villous; 2d joint shorter, thinner, nearly globular; seta a little thinner, tapering, the joints of equal length, the 4th a little shorter; mask with the basal part equilateral, bent down anteriorly and produced in an obtuse angle; palpus triangular; movable hook inserted more at the outside, extending beyond the base of the opposite one. Wing cases reaching 7th segment; abdomen large ovate, side margin sharp, on the last segment villous; last segment very short; lateral spines on 8th and 9th segments very short and sharp; dorsal hooks on 2d to 10th; the

first ones smaller, erect, the following large compressed, as long as the segments, the sharp tip bent backwards; on 10th less elevated, the tip extending beyond the segment. Anal appendages forming together a hairy pyramid; the dorsal median broad at base, as long as the inferiors; laterals sharp, a little shorter; the tip of all blackish. Legs similar to *M. transversa*, hind femurs reaching 9th segment; first joint of tarsi very short.

The nymphæ were sent together, and from the same locality as the imago of *M. Moorei*.

9. *MACROMIA AMPHIGENA*. (Supposition.)

Selys, Synops. Cordul., p. 101.

One young dry nympha from Kanagava, Japan, from Mr. Gulick, sent in the same lot with the imago. Length, 20 mm.; breadth, 9 mm.

The nympha is not in good condition, and had been covered with a black varnish, which cannot be entirely washed off. Head transverse, breadth twice length; forehead very concave, eyes conical, prominent, with a transverse waved suture; vertex small, slightly convex; pyramidal horn narrower at base, a little longer than broad, side margins convex, tip sharp; antennæ as long as head, 1st joint very thick, nearly as broad as long, 2d shorter, conical, not half as thick as 1st, seta thinner, joints of equal length; occiput larger than forehead, behind broadly notched; sides convex below; on each hind angle an erect tubercle; behind the vertex an excavation with some fine linear impressions; the centre of the occiput is the most elevated part, from which lead excavations forward, backward, and on both sides; on each side of the centre a low, rounded tubercle; mask as in *M. transversa*. Prothorax similar; wing cases short, covering 4th segment. Abdomen similar to *M. transversa*; but lateral spines on segments 8 and 9 very short, those of 9 not exceeding 10th segment; dorsal hooks on 2 to 9, but less pointed, nearly straight; behind appendages similar, a little longer, forming a pyramid, less broad than long; ventral side of abdomen and legs as in *M. transversa*.

The nympha is similar to those of *M. transversa*; the most prominent differences are the form of the head, especially of the occiput, and the short lateral spines of the abdomen.

LEGIO CORDULIA SELYS.

These nymphæ have the anterior part of the head flat, never developed in a pyramidal horn as in *Macromia*; and the legs are much shorter.

The large genus *Cordulia* is divided into nine genera, of which the nymphæ of only two, *Cordulia* and *Epithea*, are known. These are the most nearly related to each other of the nine genera. The general description of *Macromia* has been purposely given in a very detailed manner; therefore it would be useless to repeat here those details. In fact, *Cordulia* as far as known is very homogeneous, and it may be stated that the body is decidedly larger and more bulky, and the legs stronger and shorter.

The genus *Epithea* differs from *Cordulia* (proper) in the tendency, in some species, of the anterior part of the forehead to be somewhat thickened, a slight homology to the horn of *Macromia*, and in the presence of two erect spines behind the eyes. The body is shorter and flatter, the dorsal hooks of the abdomen strongly developed; the lateral spines longer and stronger. The genus *Cordulia* is comparatively spineless, has the body longer and more cylindrical, the dorsal hooks absent or less developed, the lateral spines short and insignificant.

It is impossible to say more till more nymphæ are known.

10. EPITHECA BIMACULATA. (Raised.)

PLATE III. FIG. 2.

Charpentier. Selys, *Revue*, p. 66.

Nympha. Frisch, *Insecti*, VIII. p. 20, pl. 9. Hagen, *Stett. E. Zeit.*, XIV. p. 263. 3.

Brauer, *Neur. Austr.*, p. xv.

Length, 31 mm.; breadth, 11 mm.

Seven nymphæ skins from Wilkie, near Königsberg, East Prussia, June 4, 1845, secured in transformation by H. Hagen; a much larger number compared. Body large, elongated, naked; head about half as broad as abdomen; a little longer than half its breadth: eyes nearly in middle of sides, which slope before and behind, conical, prominent, rounded on top, an angular prolongation behind; occiput brown with pale ill-defined band from the eyes to hind angles; a number of small black tubercles

sprinkled about, and small bristles on the rounded sides; a transversal much waved suture behind the eyes; in middle two large ovoid spots, and in front of them two prominent conical tubercles, sharp on tip; occiput behind with shallow notch; forehead a little convex, brown with a white middle band, forked at base and covering the little indicated ocelli, on each side a pale band extending outside of antennæ; vertex small, rounded; forehead sprinkled with black dots; antennæ long, extending beyond the lower edge of palpus, thick, seta a little thinner; 1st joint cylindrical, 2d equally long, thinner at base, rounded on tip; 3d less long than the basal ones together, 4th much shorter and 5th little shorter than 3d, 6th as long as 3d, 7th short subuliform; mask short, distinctly spoon-shaped, extending between fore legs; basal part as long as broad, front part bent down, and produced in an obtuse angle; palpus large, triangular, edges straight with nine short teeth; movable hook short, sharp.

Prothorax about as broad as hind border of occiput, rounded behind with an inflated rim, sides triangular, acute, a little hollowed; stigma free; wing cases reaching 6th segment; sides of thorax brown above, paler below; abdomen broad, somewhat flattened, length less than twice the breadth, roof-shaped above, flat below, oblong; side margin sharp, convex, with a dense brush of short bristles; gently sloping towards base and segments 7th to 9th to tip, which is truncated; segments equal, 10th very short and inserted in a rounded apical notch of 9th; lateral spines on 8th and 9th sharp, flat, distant; those of 9th very long, surpassing the appendages; dorsal hooks on 3d to 9th, the first thin, sharp, conical, the following larger, flattened laterally, the sharp tip bent backward; on 9th more incurved, nearly connate with dorsum except on tip; anal appendages as long as last two segments, comparatively small, triangular, straight, the sharp tip hairy; dorsal median one fourth shorter than inferiors; the basal half of its dorsum squarely enlarged in the male; laterals a little shorter than dorsal; ventral longitudinal sutures straight, ending inside the apical angle of 9th segment; middle space larger than laterals; apical border of 9th segment hairy; genitals marked; ventral bags on 6th segment. Dorsum with a black dot and a larger pale mark about in the middle of each side of the segments. Legs very long, hind femur reaching 8th segment, thin, cylindrical; widely separated at base, fore legs a little less; femur bent, tibia straight, a little longer; 1st joint of last tarsus less than half as long as 2d; legs sprinkled with darker very fine dots, making two rings on femur and tibia.

11. EPITHECA PRINCEPS. (Raised.)

PLATE III. FIG. 3.

Hagen, Syn. N. Am. Neur., p. 134.
Selys, Syn. Cordul., p. 41, no. 24.

Nympha raised by H. J. Hubbard, Detroit River, Mich., June 3, 1874, in very large numbers; also in alcohol, Cambridge, Mass. Peoria, Ill., June 28, October 23; Pekin, Ill., October 9; Cedar Lake, Ill., October 12 and 18; young, all from Prof. Forbes. Length, 26 mm.; breadth, 13 mm.

Body a little shorter but as broad as *E. bimaculata*, from which it differs as follows: conical tubercles less sharp; palpus shorter, broader than long, teeth on the edge, less pronounced; abdomen shorter, length less than twice breadth; lateral spines on segment 9 shorter, on 8th very short; anal appendages a little shorter than the last two segments, the laterals thicker; the dorsal median enlarged above to the apical third.

The nympha of *E. princeps* is easily recognized by its broader but shorter body, the smaller tubercles on the head, and the shorter and straight lateral spines on the 9th segment. The rectal part of the digestive tube is mostly retained in the nympha skin in this species which is unusual. Two specimens have an oval cocoon of a parasite fixed to the abdomen; the parasite itself has left through a little round opening, so it was doubtless a Hymenopteron.

12. EPITHECA SPEC.

PLATE IV. FIG. 3.

Dry nympha from Central Illinois, August, from C. V. Riley; a little larger in alcohol, from Central Illinois, from Prof. S. A. Forbes. Length, 12 to 17 mm.; breadth, 6 to 9 mm.

Both nymphæ are apparently not fully grown, as the genitals are not yet marked; very similar to *E. princeps*, but the two tubercles on the head are much larger and more developed, erect, and form two conical horns. The supposition that these nymphæ may represent younger stages of *E. princeps* must be dismissed. Nymphæ of *E. princeps* of the same size, as well as much younger ones, were examined, and did not differ from the adult. Besides the marked difference in the size of the horns, the abdomen seems to me larger.

As many species are known, it is impossible to make a supposition.

13. EPITHECA SPEC.

PLATE VI. FIG. 4.

Two nympha skins from Bee Spring, Kentucky, June, 1874, from Mr. F. G. Sanborn. Length, 23 mm.; breadth, 9 mm.

Body oblong, truncate, a little enlarged behind; head short, diamond-shaped, a little narrower than the abdomen (7 mm.), about half as long as broad, the fore part angular, formed by the palpi; eyes blunt, slightly prominent; the transverse line behind the eyes with a slight curve on each side of the vertex, which is round, the ocelli very slightly indicated; forehead flat, square, anteriorly bent up a little, with small but numerous spines; part behind the transverse line covered with scabrous patches, and on occiput with some curved bands; antennæ reaching the lower margin of the palpus; basal joints a little thicker, 3d to 7th a little longer, joints about equal; mask extending between front legs, spoon-shaped, as long as broad; basal part four times broader in front than at the base; front border triangularly produced, obtuse-angular; palpi large, triangular, with a basal ridge; edge about straight with 6 or 7 interlocking strong teeth. Prothorax very short, narrower than the head, slightly rounded behind, flat, with a small rim behind; stigmata free; wing cases reaching the 6th segment; sides of the thorax scabrous. Abdomen, length once and a half breadth, flat-convex above, oblong, segment 9 sloping and truncate; the segments of about equal length, the last very short, annuliform, inserted entirely in the 9th; lateral spines on segments 8 and 9 flat and enlarged at base, sharp, a little incurved, longer on 9th; lateral part of those segments scabrous, and with short bristles on the inside of the spines; dorsal hooks on 2d to 9th segments strong, bent on tip; the last three short and blunt, on the 9th rudimentary; appendages as long as the last two segments, thick at base, the inferiors sharp, a little longer than the median; the laterals as much shorter than the median, sharply pointed; longitudinal ventral sutures straight, ending inside of apical tip of 9th, the spaces of about equal breadth; basal lateral angle of segments 3d to 5th separated triangularly by an elevated ridge; ventral apical border of 9th, with a fringe of hairs. Legs widely separated, long, strong; femur of hind legs about straight, reaching the 7th segment; legs blackish, femur and tibia in the middle and on tip have a luteous ring; tarsus long, first joint on hind legs little shorter than

second ; last joint longer ; a series of black spots on each side of the dorsum of abdomen.

The imago is not known. I think it may be perhaps *E. Selysii*.

There is a nearly full-grown nympha, locality unknown, in alcohol, and some similar ones from "ditch at Legs Hill, B. H. W. and C. E., May 28, 1859," the latter from the Peabody Museum, which cannot be separated from these nympha skins.

14. *EPITHECA LIBERA*. (Raised.)

PLATE IV. FIG. 4.

Cordulia libera Selys, Syn. Cordul., p. 29, no. 14.

One nympha skin and the imago raised from it, June 6, 1873, in Portland, Me., by K. T. Jones. A younger nympha, 15 mm., from Chebacco Lake, Mass. Length, 17 mm.; breadth, 7 mm.

Body nearly naked; head diamond-shape, a little narrower than the abdomen; convex between the eyes, which are conical, rounded on top; transverse suture about straight, part before dark brown, a little roughened; part behind with a yellow band along the suture; with some very small spines and longer scattered hairs; sides sloping to the narrower occiput, which is slightly notched; forehead smooth, anterior margin straight, with a fringe of longer hairs; antennæ comparatively thin, longer than the palpus; the two basal joints very little thicker than the seta, first joint short, enlarged at tip; second a little longer, elongate ovoid; seta with joints of nearly equal length, except that the first is longer and the second shorter than the others; basal part of mask a little longer than its anterior breadth, produced in a more than right angle; palpus equilateral, interlocking edge with nine flat teeth; the whole mask sprinkled with very fine brownish dots. Prothorax narrower than occiput, side angles triangular; sides of thorax with a blackish longitudinal band and a quadrangular spot below near the wings; wing covers reaching 6th segment; the hind wings with a black band on the costal spaces as far as the nodus; abdomen dilated as far as the last segments, which are sloping; somewhat flattened, on each side with a row of ill-defined paler spots and with a pale band on the middle line; side border sharp, with long hairs on the last segments; lateral spines on segments 8 and 9, flat, sharp, incurvate, very short on 8th; on 9th about one third of length of segment; dorsal hooks small blunt tubercles on the end of segments

4 to 9, only indicated on 4th, a little longer and free on 7th, on 9th and 8th better indicated; segment 9 truncate; 10th very small, annular, appendages scarcely longer than 9th, pyramidal, pointed; dorsal median shorter than inferiors, laterals shorter than median; ventral sutures straight, convergent on 9th segment; space between them larger; ventral bag on 6th segment; legs long, thin, hind femur reaching 7th segment, tibia longer with a fringe of long hairs; tarsus long, basal joint very short.

15. EPITHECA CYNOSURA SAY. (Raised).

PLATE IV. FIG. 1.

Imago. Libellula cynosura Say, Journ. Acad. Phil., Vol. VIII. p. 30, no. 19.

Epophthalmia lateralis Br., Vol. II. p. 847, no. 7.

Cordulia lateralis Hag., Syn. N. Am. Neur., p. 139, no. 15.

Nympha. Packard, First Ann. Rep. Insects of Mass., 1871, p. 379, pl. 1, f. 10.

Cf. the literature quoted fully for Macromia transversa.

Nympha skin found, June, 1869, at Wakefield, by F. W. Putnam; this is a male, the type of Professor Packard, now in the Museum of Comparative Zoölogy; a number of nympha skins, male and female, collected near Boston, Mass., by S. Henshaw. Length 20-24 mm.; breadth, 7 mm.; 9th segment with lateral spine, 4 mm.

Body elongate, naked; head little narrower than abdomen, a little longer than half its breadth; sides abruptly sloping behind; eyes conical, rounded on top; ocelli strongly marked; behind the suture two small pointed tubercles; occiput slightly notched; space between the antennæ, which are similar to *E. bimaculata*, nearly flat; mask with the basal part longer than broad, with two elevated ridges, parallel and reaching nearly the anterior border; palpus triangular, the teeth interlocking; thorax on each side with black broad longitudinal band, wing covers reaching the 6th segment; abdomen narrow, a little enlarged in middle; less roof-shaped, on each side a series of pale spots, somewhat edged with dark brown; side margin sharp, with a short fringe; segments equal, except the last, which is very short, and narrow; lateral spine of 8th very short, of 9th long and sharp, divergent, much longer than the appendages; dorsal horns on 3d to 9th, the first three like spines, the following flattened laterally, the tip bent backward, on 9th more incurved, a little longer than the segment; appendages about as long

as the last two segments, small, similar to *E. princeps*, as is also the dorsal of the male; legs as in *E. princeps*, hind femora not reaching 8th segment; 1st joint of last tarsus less than half as long as 2d; anterior and median legs with two dark rings on femur and tibia.

This species has the part of the forehead between the antennæ thickened and a little elevated; in the middle of this part there is below a bunch of bristles. It is obvious that this arrangement is an indication of, and homologous to, the frontal horn of *Macromia*. A number of specimens have the lateral spine on 9th segment only half as long, and sometimes the two tubercles on the head less developed; probably they belong to some of the numerous varieties of this species.

Dr. Packard's description is very fair; the statement that the teeth of the palpus do not interlock is to be amended.

16. *EPITHECA SEMIAQUEA* BURM. (Supposition.)

Three nymphæ skins from Massachusetts. Length, 18 mm.; breadth, 6 mm.; 9th segment with lateral spine, 3 mm.

Very similar to *E. cynosura*, but smaller, and the lateral spine half as long; tubercles on head behind suture nearly absent, only indicated; lateral spine on segment 9 shorter, only a little longer than the appendages; the dorsal median of the male thickened above at apical third. The nymphæ only differs in the shorter lateral spine on segment 9; as there are varieties of *E. cynosura*, and as *E. semiaquea* belongs probably to the same species, it seems very probable that these nymphæ belong to them.

17. *EPITHECA SPEC.*

PLATE IV. FIG. 2.

Five dry nymphæ from Kanagawa, Japan, from J. T. Gulick. Length, 20 mm.; breadth, 5 mm.

Body naked, brownish; head as broad as the abdomen, broader than long; eyes comparatively small, short, conical; transverse suture in the middle of the head, slightly convex, in the middle very slightly notched; part before the suture black, flat; vertex very little convex, the ocelli strongly indicated, yellowish; front border straight; antennæ dull yellowish, longer than the palpi, seta nearly as thick as the base; part behind the

suture short, oblique laterally, widely notched at the margin; two blunt tubercles in the middle; basal part of mask very little longer than broad, produced anteriorly in a very oblique angle; palpus equilateral, with seven strong interlocking triangular teeth; prothorax about as broad as occiput, side angles narrowed, bent up; wing covers reaching 7th segment; the shape of the abdomen looks rather unusual, and is mentioned only as it is exactly the same in all specimens; about three times longer than broad, truncate at tip, sides parallel, bulging out a little roof-shaped on the basal half; the sides much bent down; segments equal, the last very short annular; side margin sharp, ciliated; lateral spines on 8th and 9th; very short and small on 8th; about as long as the segment, flat, sharp, slightly incurved on tip on 9th; dorsal hooks on 4th (perhaps on 3d) to 9th segments, a little larger on the three last, much bent backward, above hairy, the sharp tip exceeding the segment; appendages as long as the two last segments, longer than the last lateral spine, together longer than broad at the base; inferiors sharp on tip, a little longer than the median, which above is covered on the male in the two basal thirds by an inflation cut square at tip; laterals shorter, pyramidal, sharp; ventral sutures convergent to segment 7, then straight; the 9th ventral segment a little larger; space between the sutures larger than the lateral spaces; the whole inferior face of abdomen very concave; legs thin, long; hind femurs reaching half of 8th segment; all tibiae with long hairs; first joint of tarsi short.

Among the two or three species known from Japan, there is none to which this belongs; the wing covers show a black neuration, but nothing which would resemble the pattern of *Somat. marginata* Selys. It is not obvious whether the nymphæ are nearly full-grown, as the genitals are hardly visible, except the basal inflation of the dorsal appendage of the male, which allows the decision that both sexes are among the lot, three males and two females.

18. *CORDULIA METALLICA* V. L. (Raised.)

PLATE V. FIG. 4.

Vander Linden. Selys, *Revue*, p. 69.

Nympha. Hagen, *Stett. E. Zeit.*, Vol. XIV. p. 263, no. 8. Brauer, *Neur. Austr.*, p. xv.

Nympha in alcohol, and two skins from Vienna, Austria, raised by Dr. F. Brauer, the types of my former description; two skins from Apken, near

Königsberg, East Prussia, raised, June 6, 1858, by H. Hagen. Length, 24 mm.; breadth, 9 mm.

Body oblong, enlarged and truncate behind, about naked; head short, narrower than abdomen, half as long as broad, slightly rounded in front, straight behind; sides projecting; conical eyes, slightly prominent; behind the eyes an undulating transverse crest, making on each side of vertex a light curve, a little elevated, with a comb of fine bristles; forehead about flat, vertex small, rounded, ocelli not indicated; front margin slightly rounded, with a fringe of long cilia; occiput in middle with two small conical tubercles, and on each side near the margin with a bunch of half a dozen long, thick hairs; antennæ long, exceeding the lower margin of palpus; basal joints a little thicker, 1st longer than broad, 2d longer than 1st; 3d not quite as long as the two basals together; 4th half the length of 3d; 5th to 7th equal, each a little shorter than 3d; 7th subuliform, sharp. Mask extending between front legs spoon-shaped, as long as broad; basal part four times broader in front than at base; front border triangularly produced, obtuse-angular; palpus large, triangular, edge straight, with about nine interlocking teeth; movable hook short, straight, sharp. Prothorax short, narrower than head, slightly rounded behind; middle third of the hind border with a strongly inflated rim, ending abruptly on both ends; sides a small elliptical lobe, bent upwards; stigmata free; wing cases reaching half of 6th segment; abdomen once longer than broad, oblong, roof-shaped, segments 8 and 9 sloping, the last truncate; segments of equal length; the 10th very short, entirely inserted in the rounded apical notch of 9th; lateral spines on 8th and 9th, flat, short, sharp; a little longer, the tip bent inwardly on 9th; dorsal hooks on 3d to 9th, spine-like, the last three strong, long, bent at tip; anal appendages short, as long as the two last segments, thick at base, pyramidal, not sharp at tip; dorsal median flat above, as long as inferiors; laterals a little shorter, strong, tip abruptly sharpened; longitudinal ventral sutures straight, ending inside of apical tip of segment 9; space between them broader than lateral spaces; basal angle of segments 3 to 5 separated triangularly by an elevated ridge; ventral apical border of 9th segment with a long fringe of hairs. Legs widely separated, fore legs a little less, long, strong; femur a little incurved, of hind legs reaching middle of 7th segment; tibia straight, of the four hind legs fringed with long hairs; tarsus long, 1st joint of hind legs little shorter than 2d; claws strong, a little incurved, sharp; genitals marked; ventral bag on 6th segment.

Around the dorsal hooks a round pale spot; on each side an ill-defined darker spot and two black dots on each side; scars oval, dark; femora and tibiae with two blackish rings.

19. CORDULIA AENEAE L. (Raised.)

PLATE V. FIG. 5.

Linné. Selys, Revue, p. 75.

Nympha. Roesel, Vol. II. Pt. II. pp. 26, 27, pl. 5, f. 1. De Geer, Vol. II. Pt. II. pp. 36-40, pl. 19, f. 1-7. Hagen, Stett. E. Zeit., Vol. XIV. p. 263, no. 7.

Three nymph skins, one with the imago half out, the other with the imago just out, from Königsberg, East Prussia, and four skins from Apken, near Königsberg, June 6, 1858, from H. Hagen; one from Zürich, Switzerland, from Mr. Bremi; one from Vienna, Austria, from Dr. F. Brauer. Length, 23 to 24 mm.; breadth, 7 to 8 mm.

Very similar to *C. metallica*, but differs as follows: head with a finer, less elevated line, without tubercles behind; occiput roughened with small spines as *C. metallica*, leaving some oval places without spines; vertex with indication of ocelli; two black transversal marks on each side, one near the anterior ocellus, the other above base of antenna; prothorax laterally sharper; thorax with a black dorsal band and two transversal ones on each side; dorsal hooks of abdomen on segments 3 to 9 thicker, short, more developed on 6th to 8th, on 9th only indicated; abdomen a little more truncate at tip; appendages shorter, dorsal median a little shorter than inferiors, in males the middle quadrangularly dilated; first joint of tarsi of hind legs less than half as long as second.

The descriptions and figures by Roesel and De Geer are not satisfactory, but belong with the imago to *C. aenea*.

20. CORDULIA FLAVOMACULATA V. L. (Raised.)

PLATE VI. FIG. 3.

Vander Linden. Selys, Revue, p. 73.

One male nymph skin from Apken, near Königsberg, East Prussia, raised, June 6, 1858, by H. Hagen. Length, 21 mm.; breadth, $6\frac{1}{2}$ mm.

Body smaller, naked, brown, hind legs blackish. Similar to *C. metallica*, but smaller, differing as follows: line on head a little stronger; no

tubercles, but on each side four ovoid flat spaces, with a rough stripe in these spaces; vertex more inflated, on each side with a blackish impression; antennæ with 2d joint longer, 3d a little longer than 2d; 5th to 7th equal, as long as 3d; side lobe of prothorax sharp, bent upwards; wing cases reaching half of 7th segment; abdomen smooth, lateral spines on segment 8 very short, on 9th long, sharp, flat, longer than segment 10; dorsal hooks on segments 6 to 9, sharp backward-bent spines, successively longer, the last longer than segment 10; anal appendages as long as segments 9 and 10, trigonal, sharp; dorsal median a little shorter than inferiors; laterals as long as the dorsal median, thick, tip suddenly sharpened; legs longer, thinner, femur of hind legs reaching segment 8, tibia of same legs black, pale at base and four pale wings near tip; first joint of hind tarsus one third shorter than second.

21. CORDULIA ALBICINCTA Br. (Supposition.)

PLATE V. FIG. 1.

A large number of young and nearly full-grown nymphæ from Hermit Lake, White Mountains, collected, July, 1875, by H. Morrison, and June, by Fr. Sanborn. Length, 11 to 22 mm.; breadth, $8\frac{1}{2}$ mm.

Body oblong, enlarged and truncate behind; dark brown, very hairy; head short, visibly narrower than the abdomen, diamond-shaped; about half as long as broad; eyes not much pointed; waved transverse line very little marked; head before the antennæ yellowish; antennæ long, yellowish, the two basal joints a little thicker, length of joints as in *C. metallica*; mask spoon-shaped, yellow, seven close interlocking teeth on the palpus; nine long, yellow movable spines each side internally along the mask, and similar ones along the inner border of palpus; movable hook short, very sharp; head behind the eyes dull, rough in some places; at each side and in the hind corner a bunch of irregular stiff bristles.

Prothorax narrower than the head; hind border triangular, with an inflated rim; sides with a small elliptical lobe bent upwards; stigmata long, free; wing cases reaching the 7th segment; abdomen once longer than broad, roof-shaped, a little sloping before the tip, which is truncate; lateral spines on 8th and 9th segments flat, very short, sharp, a little incurved; no dorsal hooks, even no indications of them, but a bunch of longer hairs; last segment anuliform; the other segments of equal length; anal ap-

pendages short, as long as the last two segments, thick at base, triangular and sharp on tip; upper one a little shorter; laterals one third as long as the inferiors; longitudinal ventral sutures straight; space between them broader than the lateral spaces; basal angle of segments 5 to 8 separated triangularly; body sparsely hairy, ventral apical border of 9th segment with a longer fringe of hairs. Legs long, hairy, similar to *C. metallica*.

The tip of femur and the middle of the tarsi are less dark than the rest, somewhat reddish.

C. albicincta Br. (= *C. eremitica* Scud.) is the most common species collected near Hermit Lake, so that the supposition seems to be very probable.

22. *CORDULIA SPEC.*

PLATE V. FIG. 2.

Among the nymphæ supposed to belong to *C. albicincta*, from Hermit Lake, N. H., collected, July, 1875, by H. Morrison, was one not full-grown male. Length, 18 mm.; breadth, 7 mm.

This nymphæ belongs evidently to a different species; body somewhat flatter, not rounded, very little hairy; light brownish yellow, abdomen above has ill-defined brownish bands; lateral spines, lateral appendages, and bristles on the border of segments 8 and 9 bright yellow; the under side yellow, along the abdomen three broad black bands, a character altogether unusual among nymphæ of Odonata. The difference of *C. albicincta* is shown by the longer and more slender straight lateral spines, and the longer appendages; also by thinner and shorter legs.

Probably the nymphæ belongs to one of the other four species collected near Hermit Lake, perhaps — as the nymphæ is somewhat aberrant — to the most aberrant of these imagos, *C. Walshii*, of which till now only three males are known.

23. *CORDULIA GRAYI* SELYS. (Raised.)

PLATE V. FIG. 3.

Synops. Cordulines, p. 49, no. 27; Additions I., p. 14.

An empty nymphæ skin with the imago just raised, and two nymphæ, one in alcohol, just transforming, from Queenstown, New Zealand, December 12. Length, 27 mm.; breadth, 8 mm.

Body somewhat rounded above, sloping at tip, naked; head smooth, broader than long; eyes small, little prominent; lateral part behind the eyes convex; occiput slightly notched, side angles sharper; forehead flat, straight on margin; vertex little convex; antennæ with seta little less thick than the basis; joints as usual; mask as long as wide, with eight interlocking teeth; movable hook short, blackish; abdomen more cylindrical; sloping at tip; lateral spines on segments 8 and 9 very small, sharp; dorsal hooks absent; appendages similar to *C. metallica*; legs thin, reaching 6th segment.

SYNOPSIS OF SPECIES DESCRIBED.

SUBFAMILY CORDULINA.

LEGIO MACROMIA.

Anterior part of the head transformed in an erect pyramidal horn.

DIVISION I. — PALPI NARROW, COMB-LIKE, NOT INTERLOCKING.

1. Epophthalmia? Burmeister. (Supposition.)

Nympha skin. Canton, China.

Body large, stout; head broad; wing covers spotted with black; the very aberrant form of the palpi narrow, comb-like, with very long, not interlocking teeth, separates this species from all others.

DIVISION II. — PALPI BROAD; INTERIORLY DENTICULATE, CLOSELY INTERLOCKING.

Macromia Rambur.

The anterior part of the head just in front of the antennæ transformed in a large erect pyramidal horn; a character unique among the earlier stages of Odonata.

2. M. transversa Say. (Raised.)

Nymphæ full-grown, male and female. North America.

Head saddle-shaped; abdomen truncate at tip; no dorsal hook on 10th segment; lateral spines on 9th segment long; apical ventral edge of 9th segment hairy.

3. M. illinoiensis Walsh. (Supposition.)

Nymphæ full-grown, male and female. North America.

Head flat above; abdomen more ovate, hairy; dorsal hook on 10th segment; lateral spine on 9th segment as long as the 10th segment; apical ventral edge of 9th segment not hairy.

4. **M. annulata** Var. **flavipennis** Walsh. (Supposition.)

One nymph, in transformation. North America.

Head flat above; abdomen more ovate; dorsal hook on 10th segment only indicated; lateral spine on 9th segment about as long as 10th segment; apical ventral edge of 9th segment not hairy.

5. **M. magnifica** McLachlan. (Supposition.)

Nymph skin, male. Northwestern America.

Head flat above, more convergent at the sides; abdomen elongated, lancet-shaped; dorsal hook small on 10th segment; lateral spines on 8th and 9th segments very short, sharp; apical ventral edge of 9th segment fringed with hairs.

6. **M. tæniolata** Rambur. (Supposition.)

One full-grown female nymph. Central and Southeastern North America.

Body large, bulky, villous; head broad, deeply notched behind; abdomen large, ovate; dorsal hook on 10th segment reaching beyond appendages; lateral spine on 9th segment sharp, slightly exceeding the 10th segment; ventral apical edge of 9th segment not hairy.

7. **M. spec.** (Supposition.)

Two probably full-grown nymphæ. Mexico.

Similar to *M. annulata* var. *flavipennis*; body shorter, head very broad, slightly depressed behind in middle; abdomen ovate; dorsal hook on 10th segment very small, erect, triangular, blunt at tip; lateral spine on 9th segment flat, sharp, half again as long as 10th segment.

8. **M. Moorei** Selys. (Supposition.)

Four nymphæ, none full-grown. Kooloo, Himalaya.

Body villous; head flat; abdomen large, ovate; sides of last segment villous; dorsal hook on 10th segment extending beyond appendages; lateral spine on 9th segment very short.

9. **M. amphigena** Selys. (Supposition.)

One nymph. Japan.

Head broad, concave above; abdomen similar to *M. transversa*; no dorsal hook on 10th segment; lateral spine of 9th segment very short, not exceeding 10th segment; ventral edge of 9th segment hairy.

LEGIO CORDULIA.

Anterior part of the head flat, without horn.

DIVISION I. — TWO ERECT SPINES BEHIND THE EYES.

Epitheca Burmeister.

Body shorter, flatter; dorsal hooks much developed; lateral spines long, strong.

10. E. bimaculata Charpentier. (Raised.)

Nympha skins, male and female. Europe.

Body large, elongated; conical spines behind the eyes long, sharp; abdomen long; truncate at tip; last segment very short; dorsal hooks on 3d to 9th segments; lateral spines on 8th and 9th segments sharp, flat, distant; those of 9th very long, extending beyond the appendages; apical edge of 9th ventral segment hairy.

11. E. princeps Hagen. (Raised.)

Nympha and skin, male and female. North America.

Similar to *E. bimaculata*; body shorter; conical spines behind the eyes less sharp; lateral spines on 9th segment shorter, straight.

12. E. species ignota.

Two not full-grown nymphæ. Illinois.

Similar to *E. princeps*; the two conical spines behind the eyes much longer and more developed than in the younger stages of *E. princeps*; abdomen larger.

May it not belong to *E. obsoleta* Say?

DIVISION II. — NO ERECT SPINES BEHIND THE EYES.

13. E. species ignota.

Two nympha skins. Kentucky.

Body oblong, a little enlarged and truncate at tip; head short, diamond-shaped; forehead flat, square, anteriorly with numerous small spines; dorsal hooks on 2d to 9th segments, the last three short, blunt, on the 9th rudimentary; lateral spines on 8th and 9th segments, flat, sharp; lateral part of these segments scabrous with short bristles; ventral epical edge of 9th with a fringe of hairs.

Perhaps the nympha belongs to *E. Selysii*.

14. E. libera Selys. (Raised.)

Nympha skin, and a younger nympha. New England.

Body nearly naked; head diamond-shape, convex between the eyes; mask sprinkled with fine brownish dots; abdomen enlarged at tip; dorsal hooks on 4th to 9th seg-

ments are small blunt tubercles, indicated only on 4th; lateral spines on 8th and 9th segments flat, sharp, incurvate; ventral edge of 9th fringed with long hairs.

15. *E. cynosura* Say. (Raised.)

Nympha skins, male and female. New England.

Body elongate, naked; two small tubercles behind the suture of the head; abdomen narrow, a little enlarged in the middle; dorsal hooks on 3d to 9th segments, the first three spine-like; lateral spines of 8th very short, of 9th long, sharp, divergent, much longer than the appendages.

16. *E. semiaquea* Burmeister. (Supposition.)

Nympha skins of male and female. New England.

Very similar to *E. cynosura*; tubercles of the head nearly absent; lateral spine on 9th segment only a little longer than the appendages. Perhaps this species is only a variety of *E. cynosura*.

17. *E. species ignota*.

Dry nymphæ, not full-grown. Kanagawa, Japan.

Body naked; head flat above; two blunt tubercles in the middle; abdomen unusual, truncate at tip, sides parallel, bulging in the basal half; dorsal hooks on 4th to 9th segments; lateral spines on 8th very short, as long as the segment on 9th.

***Cordulia* Leach.** (Raised.)

Body longer, subcylindrical; dorsal hooks absent or less developed; lateral spines very short.

18. *C. metallica* Vander Linden. (Raised.)

Nympha skins of male and female, and full-grown nymphæ. Europe.

Body oblong, truncate at tip, nearly naked; head short, half as long as broad, slightly rounded in front; undulated transversal crest behind the eyes with a comb of fine bristles; abdomen oblong, roof-shaped, segments 8th and 9th sloping, the last truncate; 10th very short; dorsal hooks on 3d to 9th, spine-like, the last three more bent at tip; lateral spines on 8th and 9th, short, sharp; on 9th a little longer, the tip bent inwards; appendages short.

19. *C. ænea* Linné. (Raised.)

Nympha skin of male and female, and full-grown nymphæ. Europe.

Very similar to *C. metallica*; occiput roughened, with some oval spots without spines; dorsal hooks on 3d to 9th segments thicker, only indicated on 9th; appendages shorter.

20. *C. flavomaculata* Vander Linden. (Raised.)

One male nympha skin. Europe.

Similar to *C. metallica*; smaller, undulated line on head more marked, behind on each side four ovoid flat spots with a rough stripe in three of them; abdomen smooth; dorsal hooks on 6th to 9th segments, spines sharp, bent backwards; lateral spines on 8th very short, on 9th sharp, flat, longer than 10th segment; anal appendages as long as segments 9th and 10th, trigonal, sharp.

21. *C. albicincta* Burmeister. (Supposition.)

Nearly full-grown nymphæ. North America.

Body oblong, enlarged and truncate at tip, dark brown, very hairy; head short, undulated transverse line very slightly marked; on each side near hind corner a bunch of stiff bristles; abdomen roof-shaped, slightly sloping toward the truncate tip; no dorsal hooks; lateral spines on 8th and 9th segments flat, very short, a little incurved; anal appendages short; ventral edge of 9th segment hairy.

22. *C. species ignota*.

One not full-grown male nympha. Hermit Lake, New Hampshire.

Body flatter, very slightly hairy; similar to *C. albicincta*; under side of abdomen yellow, with three longitudinal black bands; lateral spines longer and more slender.

Could it belong to *C. Walshii* Scudder?

23. *C. Grayi* Selys. (Raised.)

Nympha skin and two full-grown nymphæ, one in transformation. New Zealand.

Body somewhat rounded above, naked, sloping at tip; forehead flat; no dorsal hooks; lateral spines on 8th and 9th segments very small, sharp; appendages similar to *C. metallica*.

24. *Cordulia spec.*

Three nymphæ in alcohol, from Prof. Forbes, Pekin, Ill., Oct. 9, 1874.

It differs from the general type of the *Cordulina* larvæ, and resembles more the *Libellulina*; the eyes, however, probably refer it to the *Cordulina*. Body oval, breadth more than half length; head twice as broad as long; mask extending to middle legs; dorsal hooks present on segments 7th, 6th, 5th, and 4th, smallest on 7th, largest on 5th; lateral spines small, less developed than in *Cordulia* generally; head, antennæ, dorsal hooks, and legs hairy.

Perhaps *Libellula obsoleta* (Say).

GENERA PANTALA AND TRAMEA.

GENUS **PANTALA**. (Raised.)

Hagen, Syn. N. A. Neur., p. 141.

The full-grown nympha is rather small compared with the imago; head a little narrower than abdomen; eyes large, egg-shaped, at the hind angle of head, viewed from below conical, very prominent; vertex circular, ocelli scarcely indicated; a groove behind vertex, and another around the antenna, which is long and thin, seta not much thinner; 3d joint longest, 4th shorter; mask large, rhomboid, spoon-shaped, covering the head in front to base of antennæ; extending between base of middle legs; front part produced in a triangular lobe; palpus large, triangular, equilateral, hollowed; edged with nine large flat teeth, which do not interlock, inside four bristles on each side; movable hook short. Prothorax large, rounded behind; stigmata free; wing cases long, reaching nearly to 7th segment; abdomen half as broad as long, convex above, sides slightly rounded; no dorsal hooks; segments of equal length, 10th much shorter; on 8th and 9th long, sharp, flat lateral spines; appendages very long and sharp, pyramidal, the dorsal median a little longer than inferiors, the laterals shorter, all with short spines; ventral longitudinal sutures ending inside the apical angles of 9th segment; space between them oval, largest on 4th segment; ventral bags on 6th segment. Legs widely but equally separated at base, long, slender, longer than abdomen; claws sharp, long.

PANTALA FLAVESCENS. (Raised.)

PLATE VI. FIG. 5.

Hagen, Syn. N. A. Neur., p. 142.

Two nympha skins and raised imago males from Boston, Mass., from Mr. S. H. Scudder, and from same locality from Mr. F. G. Sanborn; a full-grown male nympha from Mass. in alcohol; three young ones 13 to 18 mm. long from Racine, Wisconsin, shore of Lake Michigan, July, 1870, from Mr. H. G. Hubbard; male and female full-grown, together with the imago, from Panama; fifteen young nymphæ from Little Town, opposite Havana, Cuba, Jan. 1, 1878, Blake Exped.; a young one dry from Brazil; a young one in alcohol from Society Islands, from Mr. Garrett; two half-grown ones from Zanzibar, from Mr. C. Cooke. Length, 10 to 28 mm.

Raised male, 26 mm. long; 7 mm. broad; compared with size of imago rather small, slender, hairless; head a little narrower than abdomen; eyes large, above not very prominent, viewed from below very prominent, conical, egg-shaped, beginning in the hind angle and covering entirely the sides of head; internally prolonged in a large flat triangular plate, reaching the vertex, not faceted, but wrinkled; vertex circular, surrounded by a flat groove; ocelli very slightly indicated; occiput flat, separated above by a short prolongation of the groove around the vertex; behind a little convex, notched near prothorax; on each side four stripes, roughened by short darkish spines and between them flat elongated spots; antennæ slender, about as long as head; the two basal joints very little thickest; 1st very short, half the length of 2d; 3d twice as long as 2d, about as long as 4th and 5th together; 4th one third of joint 3d; 6th and 7th longer, the last very pointed. Mask large, prominent, spoon-shaped, covering the head to base of antennæ, extending back between base of middle legs and in young ones as far as the hind legs; rhomboid, large, hollowed transversally between the outer angles; forehead produced in a large triangular lobe, tip nearly rectangular; palpus large, hollowed within, nearly an equilateral triangle; the edges with nine large flat teeth; on the brown tips of the teeth four spines, the lowest largest, all bent inward; the denticulations of the opposite palpi do not closely fit into one another. Movable hook short, sharp. Prothorax narrower than head, much rounded behind; stigmata free; wing cases reaching nearly end of 6th segment; venation very visible, all veins, including transversals, covered by dark brown lines. Abdomen twice as long as broad, more convex above than below, sides making a very slight curve; segments of equal length, except the last one, which is more than one half shorter, the last three tapering; segments 8th and 9th with very strong and sharp flattened lateral spines; those of 8th reaching tip of 9th segment; those of 9th longer and broader at base; anal appendages very long and sharp, longer than 8th and 9th segments together, pyramidal, extreme tips of all and of lateral spines black; the median dorsal appendage very little longer than the inferiors, its sides dilated, triangular at base, the upper edge forming a sharp keel; laterals one third shorter, more slender; inferiors large at base, tapering, bent up a little; all as well as lateral spines hairy on edges; ventral longitudinal sutures ending on 9th segment, somewhat before tip; middle space twice as broad as the lateral, a little broader on basal half of abdomen; male genitals marked on segments 3 and 9; ventral bags on segment 6. Color of abdomen palish; the dorsum variegated with light brown; segments 4 to 8 each side with two distant black dots, segment 9 with two larger black dots, one underneath the other; indentations on 4 to 8 with a brown semicircular spot; a brown spot or two near the lateral margin. Legs very slender and long; widely separated at base, the front legs a little less so; hind legs a little longer than abdomen; tibia about as long as femur, tarsus half as long; third joint as long as the two basals, first very short; claws very long, thin, sharp; femora and tibiæ with two broad brown rings on each; tarsi of the four hind legs blackish except the claws.

PANTALA HYMENÆA. (Supposition.)

Hagen, Syn. N. A. Neur., p. 142. McLachlan, Zoöl. Account, Proc. Zoöl. Soc. London, Feb. 6, 1877, p. 85, f. 1.

One nymphæ from Galapagos Islands, coll. made by H. M. S. Petrel. McLachlan.

Description and figure so like *P. flavescens*, that I am unable to find any difference whatsoever. Of course, it is possible that the nymphæ belongs to *P. hymenæa*; nevertheless it should not be forgotten that the ubiquitous *P. flavescens* may live on the same islands. Indeed, in the west of America both species occur often together.

GENUS **TRAMEA.** (Raised.)

Hagen, Syn. N. A. Neur., p. 143.

Nymphæ very similar to *Pantala*; the palpus always sprinkled with fine blackish dots; the teeth much shorter, interlocking in a nearly straight line; movable hook very long, and fine, more like a seta; joints of antennæ specifically different, fourth always shorter than third; median dorsal appendage shorter than the inferiors; laterals always without spines; legs longer, thinner, densely fringed with long hairs, especially the tibia of middle legs.

The nymphæ of all species very much alike, differing in the different length of joints, of antennæ, lateral spines, abdominal appendages, and legs. The eyes do not differ from those of *Pantala*, as one might suppose they would, judging from the difference in the eyes of the imagos.

During the transformation in the imago state the skin on the head splits along the median line of occiput, and in an anterior curve on each side along the interior margin of the eyes, both joined behind the vertex, meeting the median split of occiput. The anterior curve never passes through the eyes. *Pantala* splits similarly. All Gomphina have the eyes split transversely along the anterior curve.

TRAMEA ABDOMINALIS. (Raised.)

Hagen, Syn. N. A. Neur., p. 145.

A male nymphæ skin in bad condition, and imago, from Jamaica, raised by H. G. Hubbard. Length, 25 mm.

Similar to *T. lacerata*; head nearly destroyed; 4th joint of antenna two thirds the length of third, in *T. lacerata* half as long; palpus finely sprinkled with black dots; teeth more marked, movable hook yellow, a little shorter; abdomen similar; dorsal median appendage more slender, one third shorter than inferiors, laterals as long as the dorsal; legs similar, claws pale, no black above on middle third.

TRAMEA CAROLINA. (Raised.)

PLATE VI. FIG. 2.

Three not full-grown nymphæ in alcohol, from Charleston, South Carolina. Length, 20 to 25 mm.

Similar to *T. lacerata*; groove behind vertex deeper; 3d joint of antennæ short, little longer than the two basals together; 4th joint two thirds of 3d; movable hook long, with two long bristles; dorsal median appendage one fourth shorter than inferiors; laterals shorter than dorsals, half the length of the inferiors; claws pale, darker at tip.

A young nymph 18 mm. long from Key West, Florida, January 7, 1878, from Mr. Garman, is very similar to the foregoing ones; it differs perhaps by a little shorter lateral spines, and by a very interrupted black line on the tibia externally, which is almost continuous on the nymphæ from South Carolina. I know from Key West only *T. Carolina*, and the more common *T. onusta*, from Odenton, Md., raised by Mr. Uhler.

TRAMEA LACERATA. (Raised.)

PLATE VI. FIG. 1.

Hagen, Syn. N. A. Neur., p. 145.

Four male nymphæ, dry, and three male nymph skins, raised July 28 and August 4, 1876, in St. Louis, Missouri, by Mr. Ch. V. Riley, together with the imago. Length, 25 mm.; breadth, 9 mm.

Very much like *Pantala flavescens*; head above flat, vertex transverse-ovoid, smaller; on each side an oblique shallow groove, with lateral dilatation on each side, forming broad shallow grooves, in which the antennæ are inserted; occiput rounded, not notched; antennæ similar, longer, but 3d, 5th, and 6th equally long, 4th shorter. Mask a little more prominent; palpi thickly sprinkled with small blackish dots; edge nearly straight, with ten very short indentations, forming inside short black teeth with four spines, the lowest largest, none visible when the palpi are closed, the edges interlocking perfectly; movable hook very long, reaching nearly the opposite margin of head, extending beyond the base of the opposite antenna, pale with the basal half darker; the movable hook of *Pantala* is very short, little longer than the teeth of palpus. Wing cases reaching end of segment 7; veins not so dark and well defined; abdomen short, broad, rounded, on 4th segment longer than broad, dorsum more roof-shaped, sides more flattened; segments of equal length, but 10th only one fourth of 9th segment; lateral spines on 8th and 9th similar but longer; those of 8th extending beyond the tip of 9th segment; those of 9th as long as anal appendages, which are very similar to *Pantala*, except the dorsal median is a little shorter than the inferiors, and the laterals less slender and very little shorter than the dorsal median; lateral spines and anal appendages larger and densely hairy except the lateral appendages, which are without any hairs; tip of segments with long and fine but widely separated hairs; ventral longitudinal sutures more widely separated towards 3d segment, sloping again to base; male genitals marked only on 3d segment; ventral bags large on

6th segment; perhaps a smaller one on 5th; the last is also somewhat indicated on Pantala; dorsum variegated with brown, as in Pantala. Legs similar but decidedly longer; claws yellow, above the middle third black; tibia of middle legs externally densely ciliated, with long hairs; tibia of fore legs on the apical two thirds externally and internally with similar hairs; femur of fore legs with less long and dense hairs.

Note from Mr. Riley: "The nympha dwells among the green water-weeds Anacharis, Lemna, Utricularia; it is transparent and beautifully mottled with pale green and dark olive-green; it darts rapidly and with vigor in water, often scampering and using mostly its four anterior limbs, which stroke in unison; the mottled green characters and form are the same in very young as in the full-grown."

TRAMEA SPEC. (Supposition.)

McLachlan, Zoöl. Coll. made by H. M. S. Petrel, Proc. Zoöl. Soc. London, Feb. 6, 1877, p. 86, f. 2.

A nympha from Galapagos Islands, 19 mm. long.

McLachlan's description is very detailed, showing perfectly that it belongs to Tramea; as the wing cases extend beyond the middle of the 8th segment, the nympha must be very near transformation, and can from its small size belong only to a very small species. The characters given in description agree well with *T. Carolina*, — which is, however, much larger; but as nothing is said about the relative length of the joints of antennæ and the movable hook, a comparison with the species described above is impossible. Mr. McLachlan indicates a new species of Tramea from Galapagos Islands, with "only a very small dark anal spot on the hind wings, in this latter character differing from most of the species of Central America, and of as large size almost as *Pantala hymenæa*," but no description is given owing to the bad condition of the specimens. The small size of the nympha forbids any reference to the above mentioned imago.

TRAMEA SPEC.

One nearly full-grown female nympha, one a little smaller, and a young one, all from Rio Janeiro. Thayer Exped. Length 14 to 25 mm.

Similar to *T. lacerata*; eyes conical, laterally prominent; vertex narrow, transverse-oval, part of forehead in front of it inflated, very little separated; groove behind vertex shallow; antennæ very long, 4th joint two thirds the length of 3d, each of the following as long as 4th. Mask sprinkled with very fine black dots; teeth similar to *T. lacerata*; movable hook very long, thin, reaching 6th tooth; wing cases reaching 7th segment; abdomen similar, lateral spines longer, of 8th segment extending beyond 10th, of 9th about as long as inferior appendages, which are very long, sharply pointed, and hairy; dorsal median one third shorter; laterals a little shorter, and as usual without hairs; claws pale colored, legs longer; hind legs much longer than abdomen femur reaching 9th segment. May it not belong to *T. basalis*?

TRAMEA SPEC.

Several nymphæ and parts in bad condition in alcohol, from Porto Segaro, Brazil. Thayer Exped. Length, 17 mm., and parts of larger specimens.

The principal character showing the difference of the species is the very short dorsal median appendage, which is very pointed and only half as long as the inferior. There is among them a nympha belonging to a different species; lateral spines shorter than segments; appendages short, the inferiors thickened internally below base. The specimen is in very bad condition.

TRAMEA BASILARIS. (Supposition.)

Rambur, Neuropt., p. 35.

Two young nymphæ from Zanzibar, from C. Cooke. Length, 20 mm.

Similar to *T. lacerata*, but more elongated, abdomen narrower, its sides nearly straight; a flat but moderate groove behind the vertex; antennæ long, 4th joint less than half 3d, the following longer than 4th, darker; palpus densely sprinkled with small black dots; teeth moderately long; movable hook long, thin; inside along the superior margin of palpus nine very evident black spots; abdomen nearly twice as long as broad, sides nearly straight; lateral spines long, thinner, of 8th segment reaching end of last segment; appendages very sharp, dorsal median a third shorter than inferiors; laterals short, about half the length of the dorsal; legs long, thin, femur and tibia with indications of darker rings; posterior femora reaching 7th segment; claws pale.

The occurrence of *T. basilaris* is known in Mozambique, in Peters's Voyage, but not yet in Zanzibar.

TRAMEA STYLATA. (Supposition.)

Rambur, Neuropt., p. 37.

Five nymphæ in alcohol from a holy tank near Ibanca, Eastern India, by Rev. M. Carleton; one male nymph, dry, from Eastern India, from Prof. J. O. Westwood. Length, 16 to 25 mm.; breadth, 9 mm.

Head similar to the Ebon species; groove behind the vertex and around the antennæ wide but shallow; vertex transverse-oval, forehead before it, inflated; antennæ long, joint 3d only as long as 7th, 4th two thirds of 3d, the following longer; teeth of palpus not strong; movable hook long, reaching 6th tooth; palpus densely sprinkled with fine brown dots; wing cases reaching half of 7th segment; abdomen 9 mm. broad, slightly rounded at sides; 10th segment very short; lateral spines very long, straight, narrower, very sharp; those of 8th segment extending well beyond 10th; those of 9th nearly as long as inferior appendages, and very spinous; inferior appendages long, pyramidal, sharp, with many long spines; dorsal median one fourth shorter,

large at base, then fine and sharp; laterals a little shorter; depressions forming an interrupted brown ocellus; ventral bag on 6th segment; ventral sutures enclosing an elongate oval space, largest on 4th segment; legs similar to the Ebon species, but shorter, posterior femur reaching only 8th segment; femur and tibia with some indications of darker rings; fringes of middle tibiæ very long; claws pale.

It is probable that the nympha belongs to the only species recorded from North-eastern India, viz. *T. stylata* Rambür.

TRAMEA SPEC.

One nympha in alcohol, from Ebon, Marshall Islands, Pacific Ocean, from Rev. B. G. Snow. Length, 23 mm.

Similar to the Brazilian species, but decidedly more slender; groove behind the vertex and around the antennæ wide but shallow; of antennæ only the two basal joints are present; palpus similar, movable hook reaching 7th tooth; abdomen similar but narrower, 7 mm., sides less rounded; wing cases considering the length of the body very short, reaching 4th segment, which proves the nympha to be a rather young one; lateral spines shorter and less strong; those of 8th segment reaching tip of 9th; those of 9th considerably shorter than inferior spines; appendages shorter, inferiors with strong spines, one third longer than the dorsal median, which is very sharp and nearly naked; laterals one third shorter, smooth; legs similar in length, but much thinner; femur of posteriors reaching 9th segment; spines of the legs similar to *T. lacerata*, but longer; tip of posterior tibia with a short fringe; claws pale colored.

From the same collector was received a male imago from Ascension Island, Pacific Ocean, called Panapi by the inhabitants, and a little to the east and south of Ebon. The species is undescribed, and nearly related to *T. basalis* from Brazil. Perhaps the nympha belongs to this species.

EXPLANATION OF THE PLATES.

PLATE I.

- FIG. 1. *Epophthalmia* spec.? *a*, side view; *b*, labium; *c*, palpus with movable hook;
d, antennæ.
“ 2. *Macromia* *Illinoiensis*; nympha from Texas.
“ 3. *Macromia* *transversa*; *a*, front view of head.

PLATE II.

- FIG. 1. *Macromia* *Illinoiensis*, nympha skin, Mass.; *a*, front view of the head; *b*, side
view of abdomen.
“ 2. *Macromia* *magnifica*; *a*, side view of abdomen.
“ 3. *Macromia* *Moorei*; *a*, side view of abdomen.
“ 4. *Macromia* *tæniolata*; *a*, antennæ.

PLATE III.

- FIG. 1. *Macromia* spec. from Mexico; *a*, front view of the head; *b*, side view of
abdomen.
“ 2. *Epitheca* *bimaculata*; *a*, appendage, male; *b*, female; *c*, side view of the head;
d, antenna; *e*, side view of abdomen.
“ 3. *Epitheca* *princeps*.

PLATE IV.

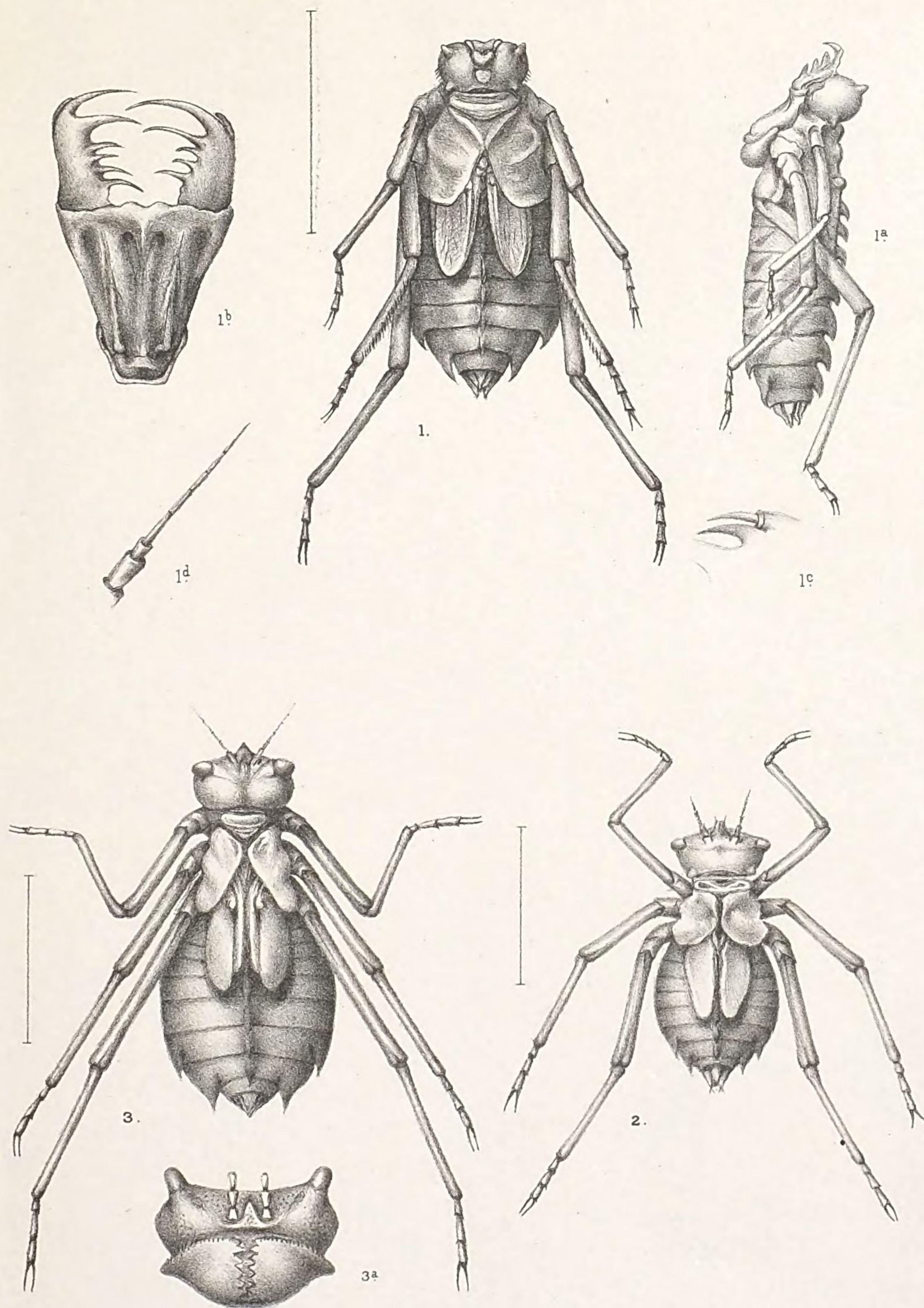
- FIG. 1. *Epitheca* *cynosura*; *a*, end of abdomen from above; *b*, side view of abdomen.
“ 2. *Epitheca* spec., Japan.
“ 3. *Epitheca* spec., Illinois; *a*, side view of abdomen.
“ 4. *Epitheca* *libera*; *a*, side view of abdomen.

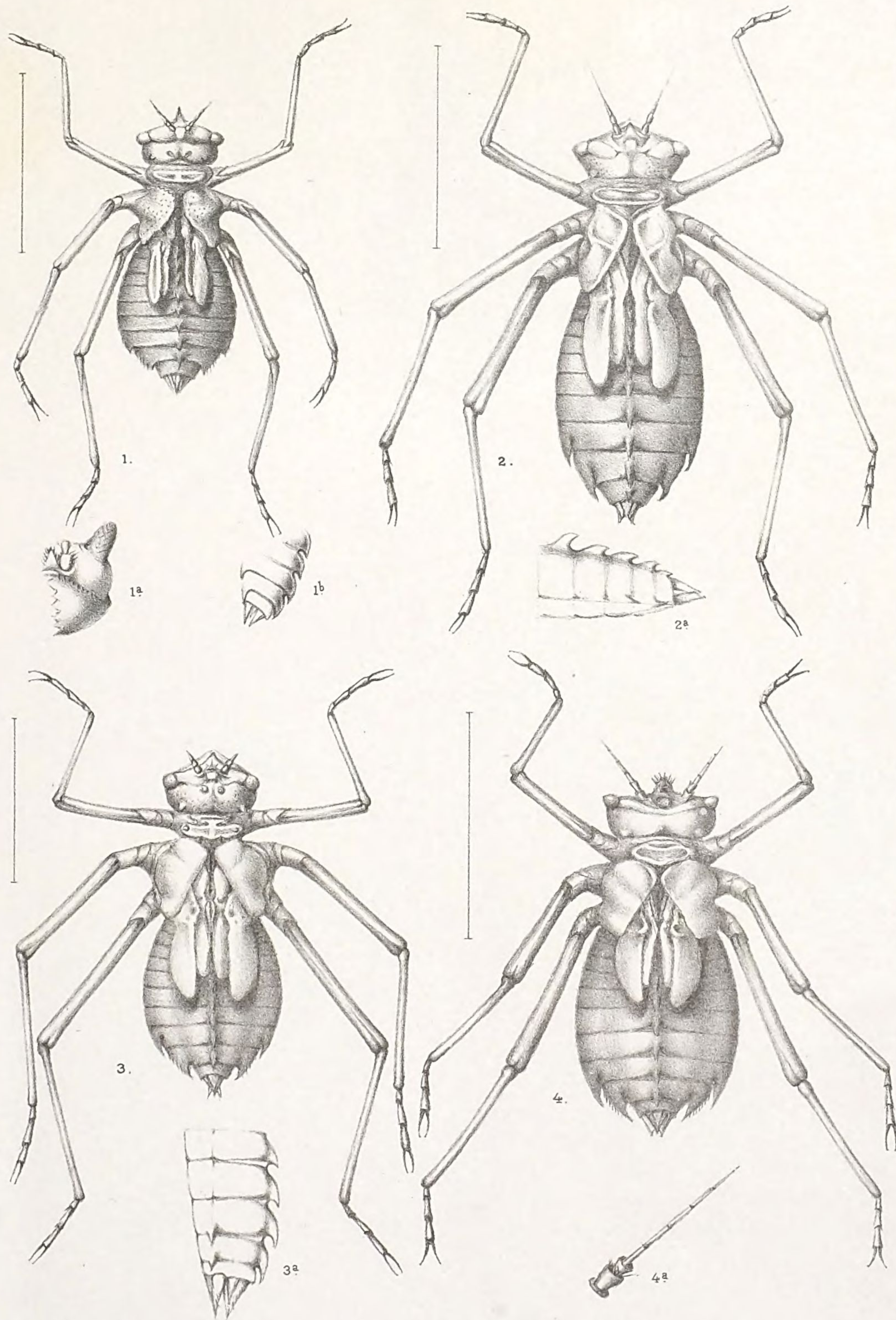
PLATE V.

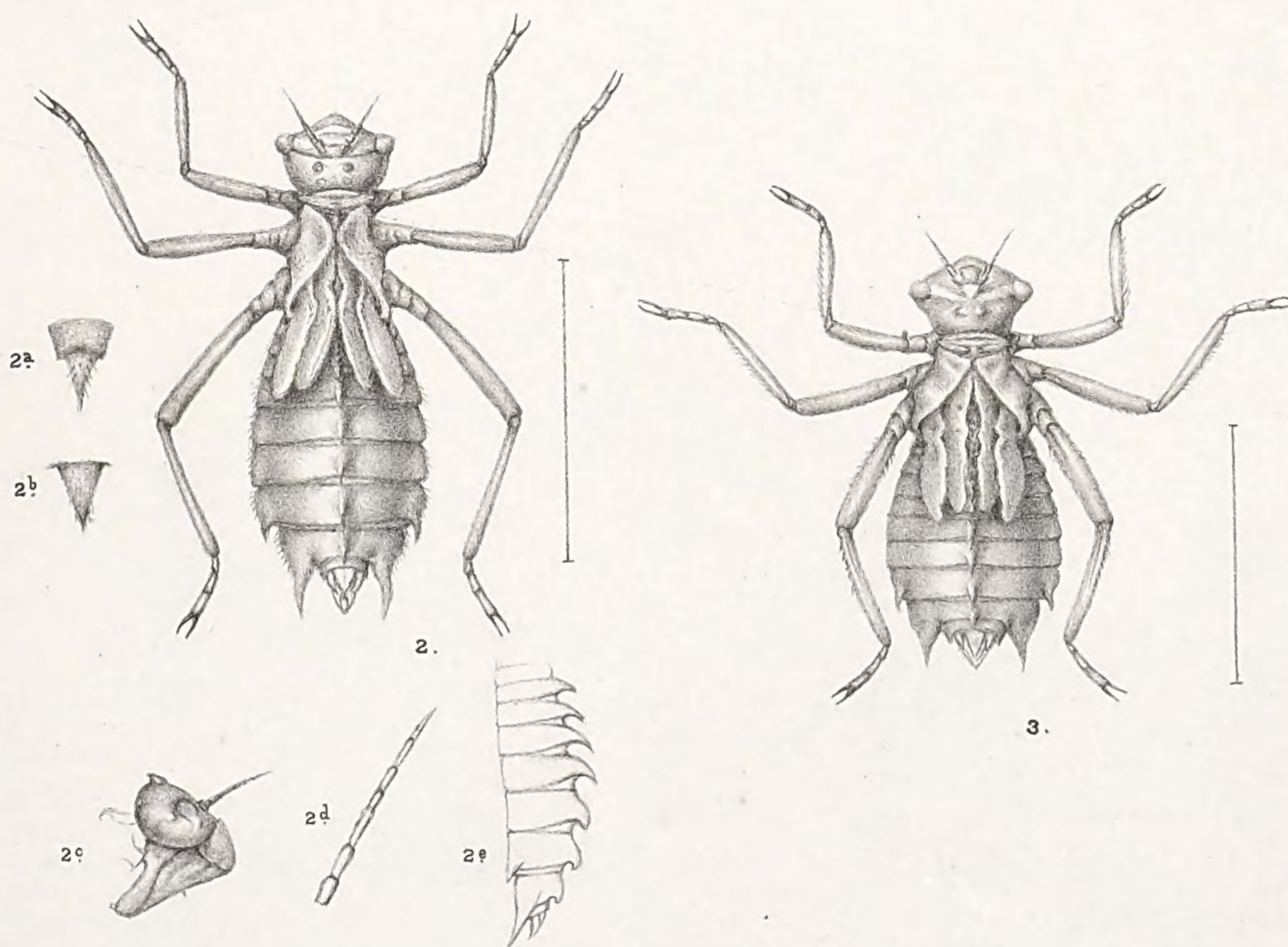
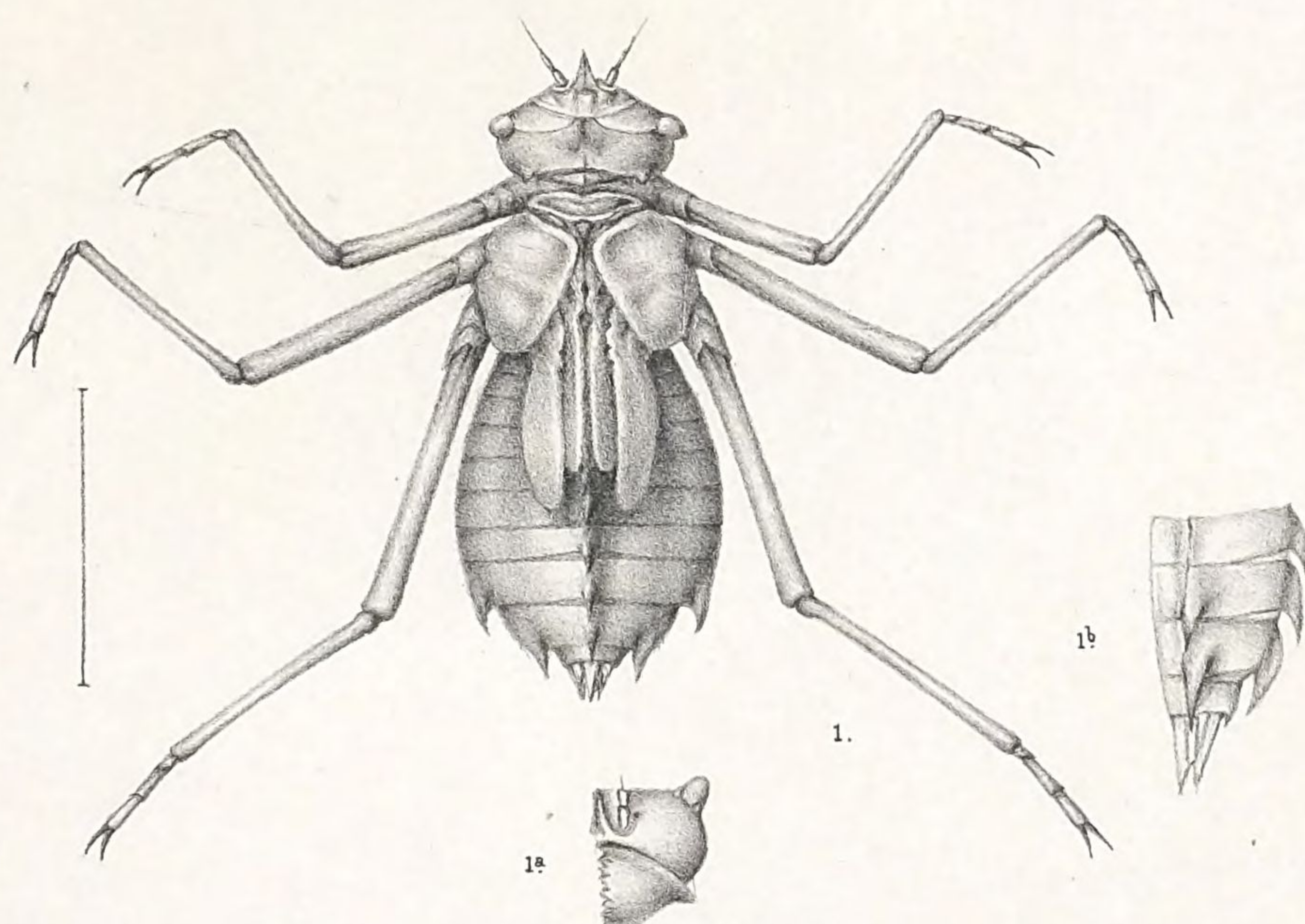
- FIG. 1. *Cordulia* *albicincta*; *c*, palpus with movable hook.
“ 2. *Cordulia* spec.; *a*, abdomen below.
“ 3. *Cordulia* *Grayi*.
“ 4. *Cordulia* *metallica*; *a*, side view of abdomen.
“ 5. *Cordulia* *ænea*; *a*, side view of abdomen.

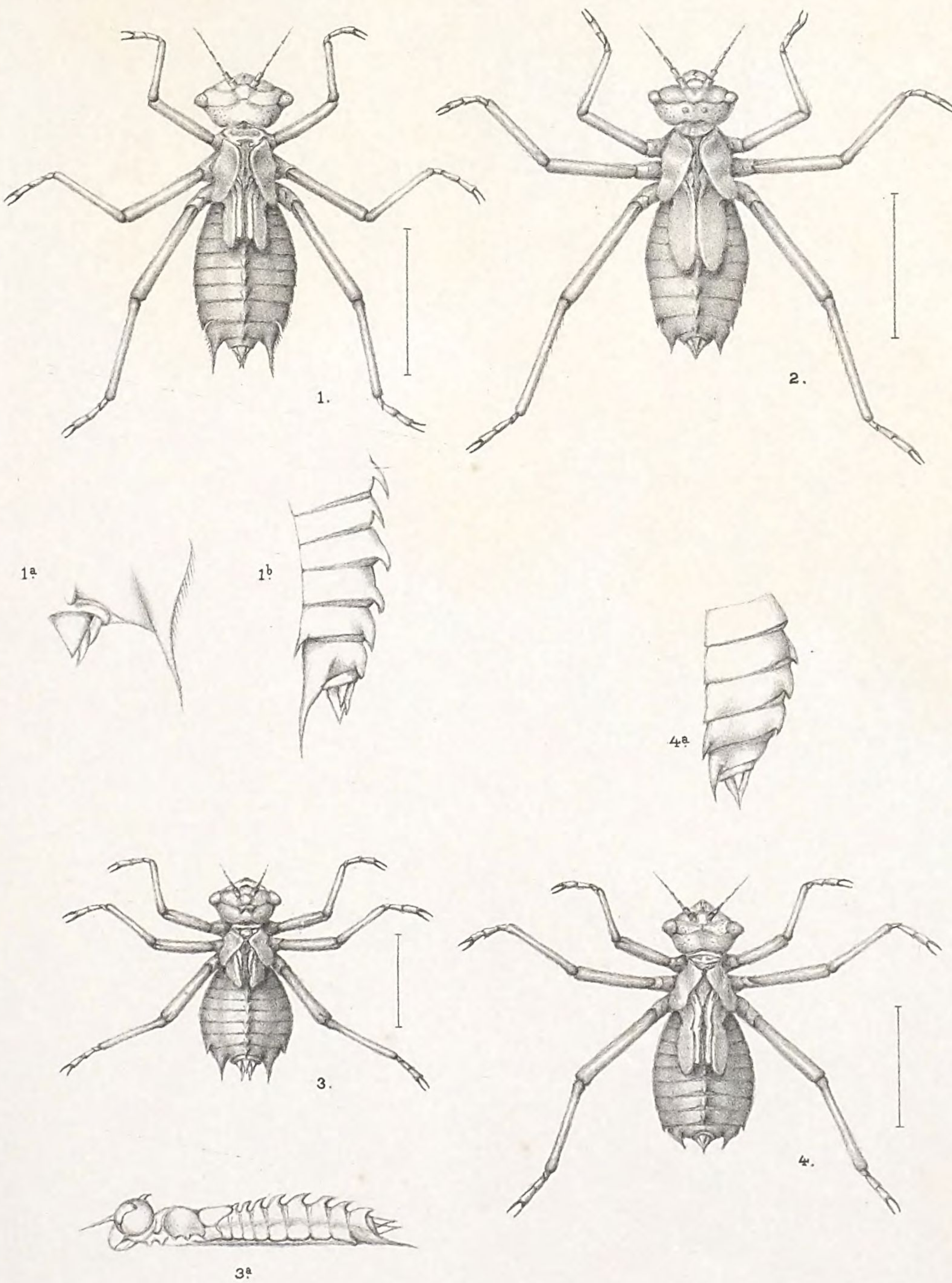
PLATE VI.

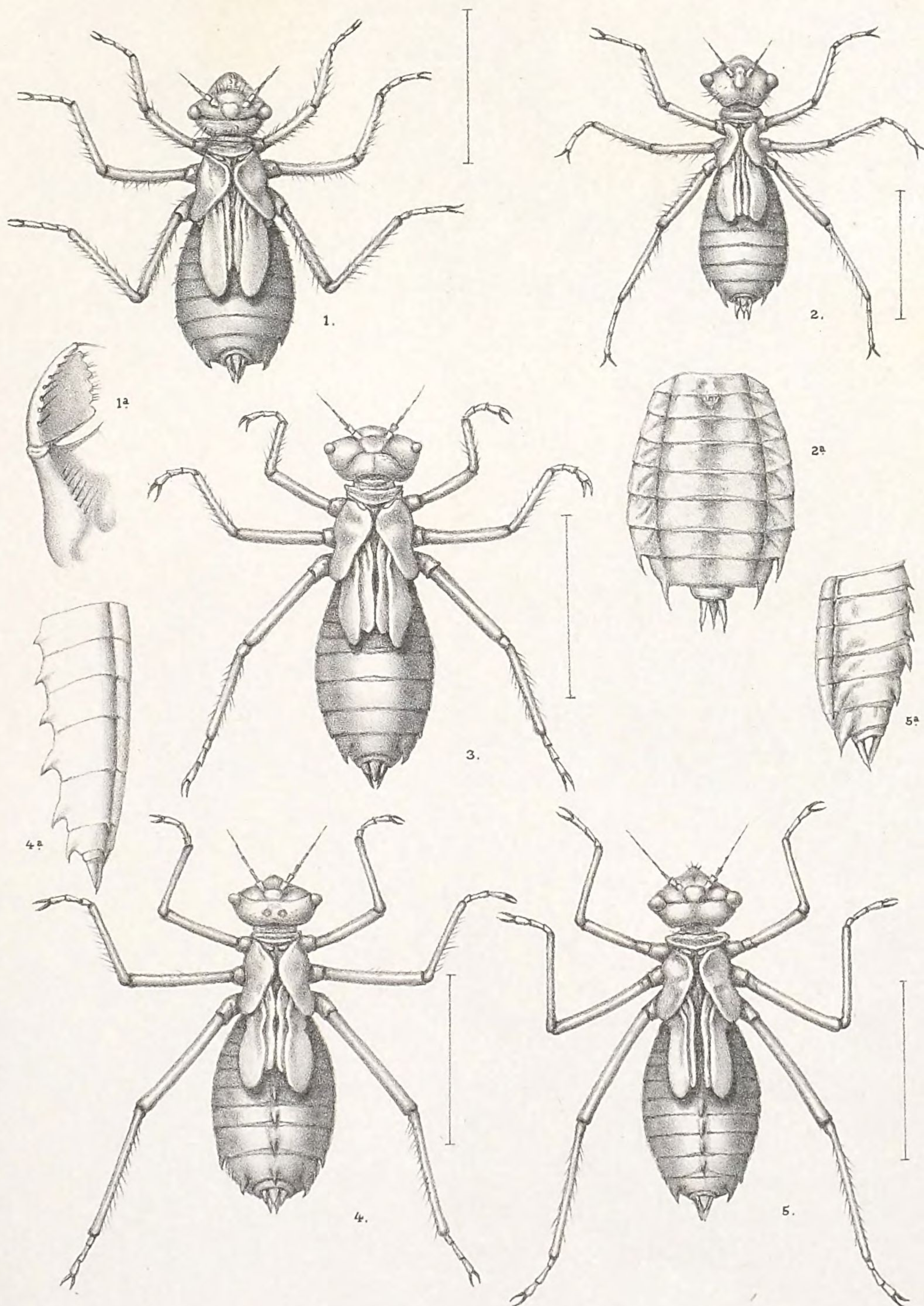
- FIG. 1. *Tramea lacerata*; *a*, appendages.
" 2. *Tramea Carolina*; *a*, appendages; *b*, the same, closed.
" 3. *Cordulia flavomaculata*.
" 4. *Epithea* spec.; *a*, end of abdomen from above; *b*, abdomen, side view.
" 5. *Pantala flavescens*; *a*, appendages.
" 6. *Cordulia* spec.

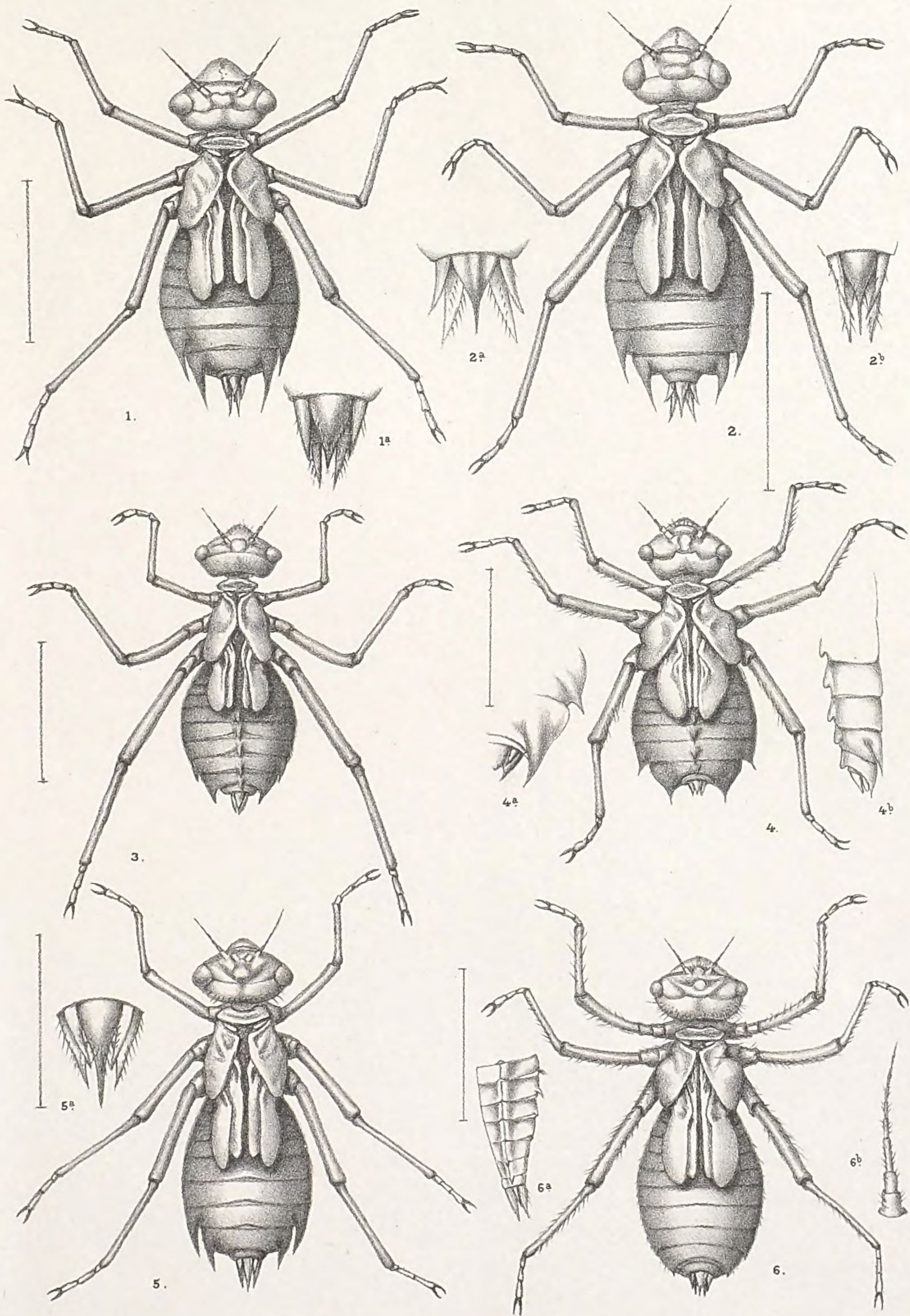












L. Cabot, del.

B. Meisel, lith.

Cabot, Louis

The immature state of the Odonata

Bd.: 3

1890

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